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ZUNI PUEBLO WATERSHED PROJECT  
Mc KINLEY COUNTY, NEW MEXICO

ENVIRONMENTAL IMPACT STATEMENT

Marion E. Strong  
State Conservationist

SOIL CONSERVATION SERVICE

Sponsoring Local Organizations

Pueblo of Zuni  
Zuni, New Mexico 87327

McKinley Natural Resource Conservation District  
P.O. Box 447  
Gallup, New Mexico 87301

Northwest New Mexico Resource Development Project Area  
1214 Mosseycup Drive  
Farmington, New Mexico 87401

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June 1975

Prepared by:

UNITED STATES DEPARTMENT OF AGRICULTURE  
Soil Conservation Service  
Albuquerque, New Mexico



## USDA ENVIRONMENTAL IMPACT STATEMENT

Zuni Pueblo Watershed Project  
McKinley County,  
New Mexico

Prepared in Accordance with  
Sec. 102(2) (C) of P. L. 91-190

Summary Sheet

- I Final
- II Soil Conservation Service
- III Administrative
- IV Description of Project: A project for watershed protection and flood prevention in McKinley County, New Mexico; to be implemented under the authority of the Watershed Protection and Flood Prevention Act (PL-566, 83d Congress, 68 Stat. 666), as amended.

The plan proposes that land treatment measures be accomplished on 11,700 acres of the Zuni Pueblo Watershed and one single-purpose floodwater retarding structure with associated outlet works be constructed during an 8-year installation period.

V Summary of Environmental Impact

- A. Elimination of flooding and associated damages in the Pueblo of Zuni leading to:
  - 1. Upgrading of homes and businesses, creating better urban environment.
  - 2. Release of public and private monies previously needed for repairs and maintenance to other beneficial uses.
  - 3. Reduction of health hazards such as vector breeding and water contamination.
  - 4. Reduction of travel and service interruptions.
- B. Reduction of flooding and associated damages occurring from a 100-year storm on 1,440 acres of prime irrigated land leading to:
  - 1. Preservation of soil resource.
  - 2. Better use and conservation of irrigation water.
  - 3. Retention of maximum option for future use.

- C. Improvement of vegetative cover on uplands leading to:
  - 1. Reduction of soil erosion by five percent.
  - 2. Increased quantity and quality of livestock forage.
  - 3. Improved forage for wild herbivorous and seed-eating wildlife.
- D. Increased production and improved composition of rangeland and shrubland vegetation on about 280 acres will create a more desirable habitat for wildlife species. Flooding will periodically interrupt wildlife and livestock use of this area.
- E. Creation of about 175 man-years of employment during construction and reduction of unemployment by about five percent.
- F. Improvement of social and economic environment by increasing income and reducing costs of maintenance.
- G. Temporary disruption of ecological functions on about 190 acres of rangeland and cropland.
- H. Removal of some areas of brush in the upland that provides nesting and cover for birds and small animals.
- I. Commitment of about 652 acres of rangeland and cropland to construction, operation, and maintenance of the floodwater retarding structure.
- J. Creation of some noise and dust pollution during construction.
- K. Creation of a potential hazard from drowning for small animals.
- L. Increased use of fertilizers that will contribute to agricultural pollution.
- M. Commitment of 11 archeological sites to mitigation salvage and excavation will result in net loss in total amount of archeological information remaining for future study and interpretation.

## VI List of Alternatives Considered

- A. Land treatment only.
- B. Floodproofing and zoning with land treatment.
- C. Floodway with land treatment.
- D. Floodwater retarding structure with land treatment.
- E. No project.



VII Comments on the draft statement have been received from the following agencies:

Department of the Army  
Department of the Interior  
Department of Transportation  
Environmental Protection Agency  
Advisory Council on Historic Preservation  
New Mexico State Engineer (Governor's Representative)  
New Mexico State Planning Office (State Clearinghouse)  
New Mexico State Historic Preservation Office  
New Mexico Environmental Improvement Agency

VIII Draft statement transmitted to the Council on Environmental Quality on February 28, 1975.



USDA SOIL CONSERVATION SERVICE

ENVIRONMENTAL IMPACT STATEMENT<sup>1/</sup>  
for  
ZUNI PUEBLO WATERSHED (NEW MEXICO)

Installation of this project constitutes an administrative action. Federal assistance will be provided under authority of Public Law 83-566, 83d Congress, 68 Stat. 666, as amended.

Sponsoring Local Organizations

Pueblo of Zuni  
McKinley Natural Resource Conservation District  
Northwest New Mexico Resource Development Project Area

P R O J E C T P U R P O S E S

The development of the project was accomplished basically through the coordinated efforts of the local sponsors, the Bureau of Indian Affairs, the Four Corners Commission, the State of New Mexico, and the Soil Conservation Service.

Formulation of the land treatment measures and flood prevention structural measures was in the framework of assisting in the full development and stabilization of the total resources and economy of the watershed.

WATERSHED PROTECTION

The primary objective is to provide watershed protection through effective land treatment and management of resources. The goals are to have in excess of 80 percent of the total land treatment needs on the land at the end of the project installation period. This minimum level was set to prevent further deterioration of the watershed lands.

Land treatment systems are based on inventories of all physical, soil, range, wildlife, and recreation resources. The land treatment measures and systems in this plan were formulated to provide for the conservation and development of the agricultural lands; to reduce sediment production, nutrient losses, and erosion; and to increase grazing production and wildlife habitat.

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<sup>1/</sup> All information and data, except as otherwise noted by reference to source, were collected during watershed planning investigations by the Soil Conservation Service, U.S. Department of Agriculture.

## FLOOD PREVENTION

The primary objective of the sponsors for this project is to provide protection to the Pueblo of Zuni and surrounding irrigated lands from floodwater and sediment deposition. The goals established by the sponsors to achieve this objective included controlling the floodwater and sediment from the Oak Wash drainage area for all storms up to and including the 100-year frequency event.

The sponsors recognized that a watershed project on this watershed would not control flooding in the Zuni Pueblo from overflow from the Zuni River.

## P L A N N E D   P R O J E C T

### LAND TREATMENT MEASURES

Land treatment measures will be applied on Indian lands and state-leased lands in the combinations needed to achieve proper use and adequate treatment. This will be achieved by land operators through complete conservation plans with the McKinley Natural Resource Conservation District.

Land treatment practices such as proper grazing use, deferred grazing, livestock water development, brush management, range seeding, grade stabilization structures, and debris basins will be applied on the uplands. Adequate fences and livestock water facilities are necessary before a desirable deferred grazing system can be initiated. Needed facilities have been identified in conservation plans with the McKinley Natural Resource Conservation District and will be installed according to schedule.

Land treatment measures such as conservation cropping systems, crop residue management, hayland planting, hayland management, pasture planting, and pasture management will be applied on the irrigated cropland. In addition, irrigation systems will be installed and managed so that high efficiency in water application and use can be achieved.

Technical assistance will be provided in planning and applying the land treatment systems by the Soil Conservation Service and the Bureau of Indian Affairs.

Land treatment measures applied on state-owned land will be maintained by the operator. The operator has a cooperative agreement with the McKinley Natural Resource Conservation District. The Pueblo of Zuni will maintain land treatment measures installed on the Zuni Reservation lands.

Installation of land treatment will take place over an eight-year period.

## STRUCTURAL MEASURES

One floodwater retarding structure will be constructed to provide protection to floodplain lands. (See Figure A.) The structure will control the sediment and runoff from 13.4 square miles of drainage area which is 94 percent of the area contributing runoff into the problem area. The locations of the structural measures are shown on the project map.

The dam will be an earthfill with a compacted earth core. The dam will be about 60 feet high and approximately 7,000 feet long. The capacity of the dam below the crest of the emergency spillway is 4,736 acre-feet, of which 3,913 acre feet is for the anticipated 100-year sediment volume, and 823 acre feet is for detention storage to retard the 100-year storm runoff. The embankment will be vegetated. It will also be fenced to provide protection from grazing and other factors that would be detrimental to the structure.

The dam will be constructed of compacted earthfill. Materials available for borrow in the reservoir are silty sands (SM) and clays of low plasticity (CL).

The dam will be constructed over a foundation of CL and SM materials. Depth to rock is estimated to be 30 feet or more. Minor settlements can be expected, but large, differential settlements are not anticipated. The principal spillway can be set on a uniformly yielding foundation.

The principal spillway is planned as a 30-inch diameter reinforced concrete pipe supported by a concrete cradle. The inlet riser will be provided with an ungated opening, sized to drain the flood volume produced by a 25-year, 6-hour storm, in a maximum of 96 hours. The crest of the riser will be set at the top of the 100-year sediment pool (Table 3). The principal spillway will discharge through a 36-inch diameter reinforced concrete pipeline, approximately 8,000 feet in length, through an energy-dissipating structure (impact basin) into the Zuni River. A pressurized manhole will be provided in the connecting box at the end of the principal spillway. Pressurized manholes will be provided every 1,000 feet along the pipeline. The floodwater retarding structure will have a dry pool.

A concrete emergency spillway with an energy dissipating outlet is planned in the left abutment. The emergency spillway and principal spillway have a combined capacity to pass the routed freeboard hydrograph without overtopping the dam.

Installation of structural measures will require land rights to be obtained on a total of 652 acres. The minimum land rights required will be those necessary to construct, operate, maintain, and inspect the structural works of improvement; to provide for flowage of water in, upon, or through the structures; and provide



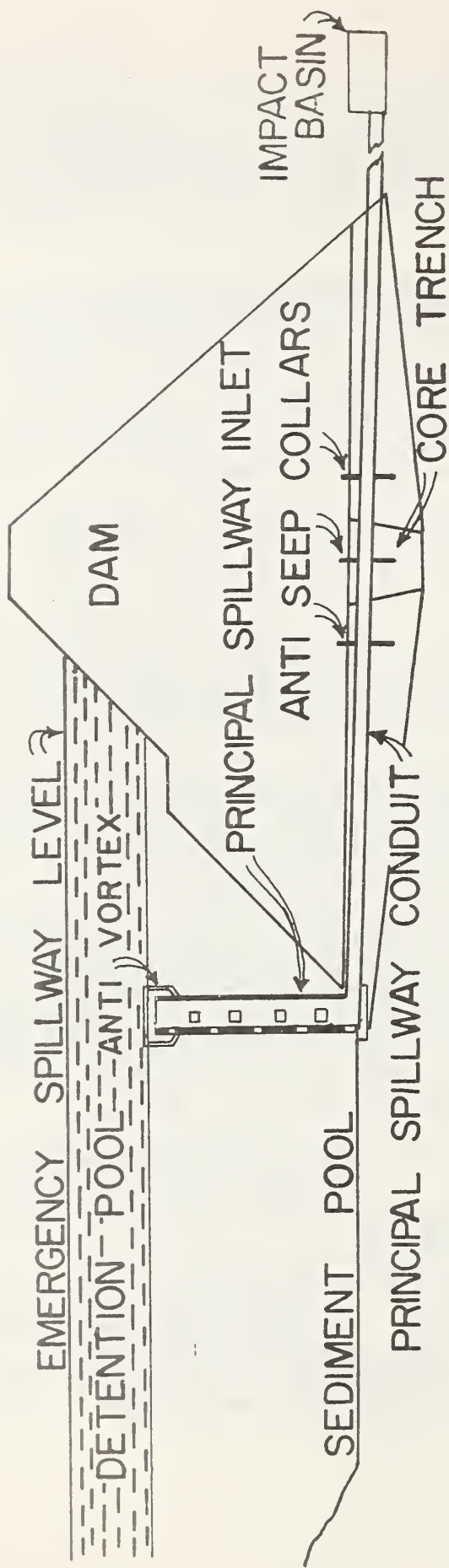


FIGURE A  
SECTION OF A TYPICAL

FLOODWATER RETARDING STRUCTURE

for the permanent storage and temporary detention, either or both, of any sediment and water. The land rights include a flowage easement up to an elevation of 6,388.3 feet or about 280 acres. This area includes 225 acres for the retarding pool and 210 acres for the sediment pool. The borrow area consists of about 130 acres and is located within the sediment pool.

The installation of the floodwater retarding structure will require the commitment of 45 acres of rangeland for the dam and spillway. The land rights for the installation of the pipeline will require 13 acres. Of the 13 acres, about 3 acres are located in rangeland and 10 acres will be located in cropland. An additional 314 acres are needed for a temporary easement for construction operations.

These areas will not be available for public use. There will be no required alteration, modification, or change in location of existing improvements.

The Archeological Center, University of Arizona, and the National Park Service provided information on the location of places of archeological or historical value in the construction area. The Arizona State Museum has prepared a proposal for further archeological investigation in the project area; this is included in the report, "Impact of the Oak Wash Dam Project on Archeological Sites near Zuni, New Mexico", by Ric Windmiller, dated April 23, 1973. This proposal provides for the systematic recovery of data from 18 sites. The program would involve adequate data recovery to provide a broad range of information regarding the structure, content, and age of the sites. This program would permit inferences concerning the social groupings resident at the site, their activities, and the relationships between sites.

Both testing and intensive excavation are recommended as the first step in mitigation. Since it was impossible to determine the extent of a number of sites from surface collections alone, initial testing is recommended for these sites prior to planning and funding full-scale excavation. (See Figure 2 of Appendix C.)

The detailed archeological investigations will be carried out in two complimentary phases under the direct supervision of a qualified professional archeologist:

Phase One is excavation and testing of sites with high probability of destruction from dam construction and floods predicted for the 100-year intervals or less. This will require initial testing and possible further excavation of two sites: ZOW 4 (N.Mex.G:13:22) and ZOW 5 (N.Mex.G:13:23). Excavation will be necessary at five sites: ZOW 6 (N.Mex.G:13:24), ZOW 11 (N.Mex.G:13:29), ZOW 13 (N.Mex.G:13:31), ZOW 14 (N.Mex.G:13:32), ZOW 15 (N.Mex.G:13:33), ZOW 19 (N.Mex.G:13:37).

Phase Two will require initial testing and possible further excavation of two sites: ZOW 16 (N.Mex.G:13:34) and ZOW 17 (N.Mex.G:13:35). One site, ZOW 12 (N.Mex.G:13:30), should be excavated, and further excavation of ZOW 4 and ZOW 5 may be necessary.

To avoid further impact on archeological resources, borrow sites will be located at sites where intensive survey by a professional archeologist has determined that there are no significant archeological resources. 1/

The National Register of Historic Places has been consulted, and no properties in McKinley County listed on the National Register will be affected by the Oak Wash Dam project.

There will be no displacement of people by the installation of the works of improvement. Presently, three grazing allotments are located within the proposed sediment basin and floodwater detention pool. These lands are owned by the Zuni Tribe, and the grazing allotment can be relocated at no cost to the Indians.

Preventative measures will be taken to minimize soil erosion during construction. Contractors will be required to adhere to strict guidelines set forth in each construction contract. Excavation and construction operations will be scheduled and controlled to prevent exposure of extraneous amounts of unprotected soil to erosion. Measures to control erosion will be uniquely specified at each work site and will include, as applicable, use of temporary vegetation or mulches, diversions, mechanical retardation of runoff, and traps. Harmful dust and other pollutants inherent to the construction process will be held to minimum practical limits. Haul roads and excavation areas and other work sites will be wetted as needed to keep dust within tolerable limits. Dust pollution tolerances will be set, and adequate monitoring will be carried out to insure that dust pollution does not exceed the predetermined levels. Proper attention will be given to workers' safety, proper clothing, and occupation health measures in accordance with the Occupational Safety and Health Act. Provisions will be made during installation for permanent recording of the types of chemicals (if any) which would be applied to the land, the rate of application, and the total quantities of chemicals used.

#### OPERATION AND MAINTENANCE

Representatives of the local organizations and the Soil Conservation Service will make a joint inspection of the structural measures annually and after each major flood for three years following installation of the structure. The inspections will be made to determine

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1/ Information provided by National Park Service and Arizona State Museum, University of Arizona, Tucson, Arizona.



the need for maintenance and repair. Inspections after the third year following installation will be made annually by the sponsors and a report prepared by them. A copy of the report will be furnished to the Soil Conservation Service. The Service will participate in annual inspections as often as it elects to do so after the third year.

Maintenance of the structural measures shall include, but not be limited to:

1. Keeping all structures in serviceable condition by making replacements and repairs as needed. Items to be considered are the condition of the principal spillway, emergency spillway, earthfill of the floodwater retarding structure, the pipeline, including all appurtenances, and vegetative cover on the embankment.

2. The Sponsoring Local Organizations will effectively and in a timely manner perform all necessary maintenance and will operate the entire project in accordance with legal permits granted for construction.

3. Damage to the structural measures caused by large storms will be repaired by the local sponsors as part of the maintenance program.

The operation and maintenance of the structural measures will be the responsibility of the Pueblo of Zuni. The Pueblo of Zuni and the Soil Conservation Service will enter into a specific operation and maintenance agreement, in accordance with the provisions of the Soil Conservation Service Operations and Maintenance Handbook of New Mexico, prior to signing a project agreement.

# PROJECT COSTS

The estimated costs for installation of the project are presented in the following tabulation:

	Estimated Cost (Dollars) <sup>1/</sup>					
	PL-566 Funds			Other Funds		
	Non-Fed.	Total	Non.-Fed.	Land	Total	TOTAL
	Land					
	SCS 2/		SCS 2/	BIA 2/		
<u>Land Treatment</u>						
Installation			31,100	813,600	844,800	844,800
Technical Assistance			8,000	113,200	121,200	121,200
Subtotal			39,100	926,800	965,900	965,900
<u>Structural Measures</u>						
Construction	3,053,900	3,053,900				3,053,900
Engineering Services	244,000	244,000				244,000
Project Administration	346,600	346,600	3,000		3,000	349,600
Land Rights			8,600		8,600	8,600
Archeological			205,000		205,000	205,000
Subtotal			216,600		216,600	3,861,800
TOTAL PROJECT	3,644,500	3,644,500	255,700	926,800	1,182,500	4,827,000

1/ Price base 1975.

2/ Federal agency responsible for assisting in installation of works of improvement.

Annual benefit cost ratio is 1.3:1.

Included in the construction costs are clearing, site preparation, earthfill, excavation, spillways, pipeline, and cost of construction water. These costs include a 20 percent contingency allowance for unforeseen costs on all construction items.

Engineering costs include geologic foundation investigations, construction materials investigation, engineering designs, and preparation of plans and specifications.

Project administration costs include administration costs, contract administration, review of engineering plans by others, construction surveys, and inspection during construction.

The \$205,000 for archeological costs include salvaging, testing, and analysis report, preparation, and coordination. The National Park Service is programming funds for the detail archeological studies and salvaging.

## WATERSHED RESOURCES - ENVIRONMENTAL SETTING 1/

### PHYSICAL DATA

The watershed consists of the drainage of Oak Wash and several small drainages that are ephemeral streams and tributary to the Zuni River. It is located in northwest New Mexico in the southwestern portion of McKinley County and encompasses an area of about 20 square miles or 12,786 acres. The land use in the watershed consists of 2,020 acres of irrigated cropland, 380 acres of irrigated pastureland, 9,910 acres of rangeland, 300 acres of urban and built-up lands within the Pueblo of Zuni, and 176 acres of miscellaneous land. At the present time only about 666 acres of the area classified as irrigated lands are in production. The supply of irrigation water available will adequately irrigate only 1,500 acres.

The watershed is located in the Lower Colorado Region and the Little Colorado Subregion as delineated by the Water Resources Council. This Region consists of (a) the Colorado River below the Lee Ferry Compact Point which is about one mile below the mouth of the Paria River; (b) Rios Yaqui, Magdalena, and Sonita and other lesser streams that ultimately discharge into the Gulf of California; and (c) the Animas Valley, Wilcox Playa,

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1/ Note: All information and data, except as otherwise noted by reference to source, were collected during watershed planning investigations by the Soil Conservation Service, U.S. Department of Agriculture.

El Dorada Valley, and other smaller closed basins. The Sub-region includes Apache and Navajo Counties in Arizona and McKinley County in New Mexico. This Subregion contains only a small percentage of the presently irrigated soils, although most of the dry farming practiced in the Lower Colorado Region is in this area. Elevations range from 4,000 feet above sea level to over 12,000 feet on Humphreys Peak, north of Flagstaff, Arizona. Land at the higher elevations is generally forested except for interspersed open areas. Most of the timber products from the Lower Colorado Region and much productive grazing is derived from this Subregion. In general, the soils are shallow in depth, often quite erodible, and are severely dissected in places.<sup>1/</sup> Accelerated erosion is occurring in some of the upland rangeland areas.

The Pueblo of Zuni straddles the Zuni River. The population of the watershed is basically within the Pueblo, with 60 percent of the population on the north side of the river. In the year 1539, when the Zunis were first contacted by non-Indians, they lived in six villages in the general area of the present reservation. By 1705, the Indians had abandoned permanent residences in all the villages except the present Zuni Pueblo. Presently, all except about 10 Indians on the reservation, live in the Pueblo of Zuni. In 1680, there were probably about 2,500 Zunis. The population figures since then are as follows:

<u>Year</u>	<u>Population</u>
1860	1,560
1910	1,660
1941	2,252
1951	2,922
1961	4,213
1970	4,952
1972	5,223

The Pueblo, originally built on high ground, has expanded on the floodplain of the Zuni River and Oak Wash as the population increased.

Gallup has a population of approximately 18,000. The Pueblo of Zuni lies 40 miles south of Gallup, which is the major trade center for the area. Another major trade center is Farmington, New Mexico, about 100 miles north of Gallup, which has a population of 27,000. U.S. Highways 666 and 550 connect Gallup with Farmington. State Highways 32 and 53 connect Gallup with the Pueblo of Zuni. Other trade centers for Zuni include Grants, New Mexico, 77 miles to the east via State Highway 53; and Albuquerque, New Mexico, 156 miles to the east via U.S. Highway 66 out of Gallup.

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<sup>1/</sup> Lower Colorado Region - Comprehensive Framework Study - June 1971.



Major problems in the watershed are floodwater and sediment damages to urban property within the Pueblo of Zuni and to the adjacent irrigated agricultural lands and crops. The major problem areas include about 150 acres of the urban area of the Pueblo of Zuni and about 1,440 acres of the surrounding agricultural lands.

The watershed is located in the New Mexico and Arizona Plateau and Mesas Land Resource Area. In general, the soils in the lower portion of the watershed or the cropland area are deep, while the upland soils are shallow and rocky. Soil associations in the watershed are Navajo-Christianburg-San Mateo and Rockland-Travessilla-San Mateo. Approximately 614 acres (6 percent of the rangeland) that is classified as class VIII land is suited only for wildlife land or recreation. Of the rangeland portion, 3,427 acres (34 percent) is in loamy, range site; 1,947 acres (20 percent) is in sandy range site; 1,206 acres (12 percent) is in clayey range site; 783 acres (8 percent) is in shallow range site; 72 acres (1 percent) is in deep sand range site; and 2,485 acres (25 percent) is in breaks range site. Approximately 54 percent (5,357 acres) is in fair condition, 30 percent (2,976 acres) is in good condition, and 16 percent (1,587 acres) is in poor condition.

These rangelands support pinon-juniper woodland type plant species. The principal species include one-seeded juniper (*Juniperus monosperma*), gamble oak (*Quercus gambelii*), antelope bitterbrush (*Purshia tridentata*), fourwing saltbush (*Atriplex canescens*), greasewood (*Sarcobatus vermiculatus*), rubber rabbitbrush (*Chrysothamnus nauseosus*), broom snakeweed (*Gutierrezia sarothrae*), and big sagebrush (*Artemisia tridentata*). Sideoats grama (*Bouteloua curtipendula*), blue grama (*Bouteloua gracilis*), muttongrass (*Poa fendleriana*), galleta (*Hilaria jamesii*), threeawn (*Aristida* spp.), western wheatgrass (*Agropyron smithii*), sand dropseed (*Sporobolus cryptandrus*), alkali sacaton (*Sporobolus airoides*), and Indian ricegrass (*Oryzopsis hymenoides*) make up the principal grass species.

The irrigated portion includes 2,400 acres of class I through class IV lands. These lands support basically pasture, hay, corn, garden and vegetable crops. The soils are deep with slopes of one to three percent.

The watershed is within the Colorado Plateau Region of the Basin and Range Physiographic Province and is underlain by red colored mudstone, fine grained sandstone and clay shale of Jurassic and Triassic age. These rocks are all of terrestrial origin. Bare exposures of rock are common. The white and red banded Zuni Sandstone Formation rings the upper watershed in a series of steep cliffs.

The regional dip is southwest resulting from uplift of the Zuni Mountains which lie 30 miles to the northeast. Locally, bedrock dips gently southwestward.

During early Tertiary time, contemporaneous with the Zuni uplift, much volcanic activity took place in this area. This activity, renewed during Pleistocene time, has resulted in numerous basalt flows on the present landscape. The flow nearest the watershed, originating to the northeast, terminated at Black Rock Reservoir two miles east of the proposed site.

The watershed lies in a semi-arid climatic zone with relatively mild winter temperatures. Mean annual temperature is 49.8 degrees F. and the average annual rainfall is 11.6 inches, as recorded at the Black Rock Station (Zuni Airport). Record temperatures are a high of 99 degrees F. and a low of -49 degrees F. The normal frost-free period is 160 days. Rainfall usually occurs during thunderstorms of high intensity and short duration, and may be associated with severe hail.

The watershed is characterized by high, dry, open country. Oak Wash originates in the steep topography of the Zuni Mountain foothills, and flows in a southerly direction to the Zuni River. In the upper portion of the watershed, Oak Wash has an unmodified, well defined channel, typical of the arid areas of the southwest. Slopes in this portion of the watershed range from 25 to 55 percent. Approximately one mile north of Zuni Pueblo, Oak Wash crosses the Zuni Irrigation Canal and traverses Zuni Pueblo irrigated cropland. Channel capacity through this reach is reduced by sediment, resulting in flood flows being forced out of bank and spreading out into an alluvial fan flow. This reach has no defined channel. The flows traverse the irrigated agricultural unit and then flow through the Pueblo of Zuni into the Zuni River. The slopes of the alluvial fan are relatively flat, approximately 0.75 percent. Mean sea level elevations range from 6,280 in the floodplain area along the Zuni River to 7,200 feet at the upper edge of the watershed.

There is no mineral production and no known potential for mineral production within the watershed.

Domestic and municipal water is supplied from wells. The quantity and quality are adequate for present and future use. There are no surface water supplies or potential within the watershed.

There are no water quality classifications established by the State of New Mexico for these drainages.

#### ECONOMIC DATA

Approximately 8.4 square miles of the watershed is owned by the State of New Mexico and leased to a private operator. The operator incorporates this rangeland with his adjacent private lands as part of his cow-calf grazing operation.

The remaining portion of the watershed is owned by the Zuni Indian Tribe and includes rangelands, irrigated cropland, and pasture-land. Approximately 10 years ago, the rangeland portion was used entirely for sheep operations. The trend is to cattle operations. Today 50 percent sheep and 50 percent cattle operations exist in the area. Rangeland is considered to be worth \$35 to \$50 per acre.<sup>1/</sup>

The cropland and pastureland portion of the watershed is divided into about 240 operating tracts, which average approximately 10 acres in size. The crops grown are mostly alfalfa, corn, and garden vegetables. Average yields are 2 tons of alfalfa and 20 bushels of corn per acre. The farm land is irrigated from a storage reservoir and is considered to be divided into family type farms. About 1,440 acres are located in the floodplain of Oak Wash. The farm units are accessible to good roads and state highways. The land is valued at as much as \$500 per acre.

Ownership of Zuni Reservation land is vested in the Zuni Tribe. However, the household traditionally is the custodian of certain parcels of land, irrigated or grazing lands, or both, and the household receives the products of the land. The traditional farming areas and grazing areas are passed from generation to generation in the household.

The farm and ranch units are classified as low income producing units employing less than 1-1/2 man-years of labor. The Zunis seek additional income from other sources such as silversmithing. Low per capita personal income is reflected in the following table:

<u>Per Capita Personal Income</u>			
<u>Year</u>	<u>Zuni <sup>1/</sup> Pueblo</u>	<u>New <sup>2/</sup> Mexico</u>	<u>United <sup>2/</sup> States</u>
	\$	\$	\$
1968	580	2,666	3,434
1970	906	3,044	3,910

<sup>1/</sup> Zuni Pueblo Records, B.I.A.; unemployment rate in 1969 was 17 percent.

<sup>2/</sup> U.S. Department of Commerce, Office of Business Economics.

The watershed is in the Northwest New Mexico Resource Development Project Area, which corresponds with New Mexico State Planning and Development District One. In addition, it is within the Four

<sup>1/</sup> Land values furnished by Bureau of Indian Affairs, Appraisal Section.



Corners Economic Development Region, designated under Title V of the Public Works and Economic Development Act of 1965. The following tabulation relates some of the socioeconomic characteristics of the subregion.<sup>1/</sup>

County	P o p u l a t i o n						Income:	% Less
	Minority Races						per	than
	Rural	Urban	Spanish	Indian	Negro	Other	Capita	Poverty
Apache, AZ	:32,298:	-	: 2,379	:23,994:	416	: 154	: 1,282:	52.7
Navajo, AZ	:34,890:	12,825	: 5,357	:23,023:	916	: 351	: 1,687:	39.2
McKinley, NM	:24,654:	18,554	: 8,626	:26,507:	410	: 294	: 1,717:	40.1

The following tabulations relate the socioeconomic data for McKinley County:

INDUSTRY OF EMPLOYED PERSONS <sup>1/</sup>  
TOTAL EMPLOYED, 16 YEARS OLD AND OVER

Industry	No.	%
Agriculture, Forestry, Fisheries	150	1
Mining	319	3
Construction	670	6
Manufacturing	1,049	9
Railroads and Railway Express Service	512	5
Trucking Service and Warehousing	96	1
Other Transportation	77	1
Communications	124	1
Utilities and Sanitary Services	174	2
Wholesale Trade	303	3
Food, Bakery, and Dairy Stores	240	2
Eating and Drinking Places	465	4
General Merchandise Retailing	256	2
Motor Vehicle Retailing and Service Stations	478	4
Other Retail Trade	806	7
Banking and Credit Agencies	119	1
Insurance, Real Estate, and Other Finance	91	1
Business and Repair Services	220	2
Private Households	93	1
Other Personal Services	431	4

<sup>1/</sup> General Social and Economic Characteristics, New Mexico, 1970 Census of Population, U.S. Department of Commerce, Table 123.

<sup>1/</sup> Western U.S. Water Plan Socioeconomic Characteristics, January 1973.



## FISH AND WILDLIFE RESOURCES

The project area is composed of several different plant communities that provide distinct terrestrial environments that are capable of supporting associations of wildlife species. There are no permanent aquatic or wetland environments in the watershed that support stable populations of wildlife species.

The Zuni Irrigation Unit, an area of 3.75 square miles (18.8 percent of the project area), is within the project area. It comprises a block of very diversified cropland and pastureland associated habitats. Much of the irrigable land has been idle or only infrequently cropped, resulting in large stands of annual weed growth. Intermingled fields of corn, vegetable crops and alfalfa occur throughout the unit.

Considered as a composite, the unit furnishes excellent habitat for small rodents and the weasels (*Mustela frenata*), skunks (*Mephitis mephitis*), and marsh hawks (*Circus cyaneus*), which feed upon them. Ground feeding songbirds, mourning doves (*Zenaidura macroura*), and scaled quail (*Callipepla squamata*) utilize the abundant weed seeds that are produced.

The rangeland portion of the watershed, which amounts to 15.5 square miles (77.5 percent of the project area), includes a number of different habitat types, as reflected by the six major range sites, as well as past land uses and treatments.

All range sites, excepting the breaks and escarpments, have deteriorated due to erosion resulting from past overgrazing by domestic livestock. Total vegetative production, and particularly that of preferred browse species, is much less than the potentials of the sites. Plant communities are simple ecosystems occurring on fragile soils, and can only support simple animal associations at low population levels.

A typical wild animal community now being supported on the rangeland habitats will include the collard lizard (*Crotaphytus collaris*), prairie rattlesnake (*Crotalus viridis*), Ord kangaroo rat (*Dipodomys ordi*), pocket mouse (*Perognathus* spp.), horned lark (*Eremophila alpestris*), raven (*Corvus corax*), badger (*Taxidea taxus*), and coyote (*Canis latrans*).

The range habitats furnish only extremely marginal conditions for scaled quail, with populations estimated to be 0 to 10 birds per section. By comparison, average statewide habitats will support 50 to 60 birds per section, and good habitats will support 150 to 200 birds per section in good years.<sup>1/</sup>

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<sup>1/</sup> Data furnished by N.M. Department of Game and Fish.

The range habitats within the watershed area do not presently support resident mule deer (*Odocoileus hemionus*). Only 8 percent of the watershed area currently provides any significant density of preferred browse species that are needed for mule deer habitat. Bitterbrush, while occurring in densities of 400 to 3,000 plants per acre, exhibits indications of past overuse with 40 percent of the plants in a decadent condition. Current utilization of bitterbrush is 30 to 40 percent of new plant growth. Mule deer occupy adjoining ranges outside of the immediate watershed, and are known to move through this watershed.

Data published by the New Mexico Department of Game and Fish<sup>1/</sup> describes Game Management Unit 29 (of which the Zuni Reservation comprises 83 percent of the 864 square mile area in the unit) as consisting of only 30 percent suitable mule deer habitat. Annual habitat condition evaluations, including population estimates, are not conducted by the Department on Unit 29 because "it is generally only marginal deer habitat . . . heavily overused by sheep . . . and because of its relative unimportance in deer management".

Hunting on the Zuni Reservation is managed by the Zuni Game and Fish Department. In 1973 there were about 575 deer hunting permits sold, with an estimated 5 percent hunter success reported.<sup>2/</sup> By tradition, the Zuni people do not engage in sport hunting for quail, mourning dove, or waterfowl species.

Sport fishing on the Zuni Reservation is provided in six multiple-purpose reservoirs, none of which are in the watershed. The Zuni Game and Fish Department issues daily or seasonal permits. Management of the fisheries, including stocking, is the responsibility of the U.S. Fish and Wildlife Service, USDI.

The watershed area does not contain resident or breeding populations of threatened wildlife species as described in the 1973 Edition - "Threatened Wildlife of the United States". The Southern bald eagle and the peregrine falcon are known to seasonally frequent this region of the state, and it is expected that individual birds may fly over or hunt in the watershed.

## RECREATION

There are no developed recreational facilities in the watershed area. The sponsors have not expressed interest in making recreation a project objective. The watershed area has no potential for the development of water-based recreation.

The Zuni Pueblo has carried out a long-term program of providing outdoor recreation opportunities for both the tribe and general

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<sup>1/</sup> Game Surveys, Federal Project W-93-R-5 to 15.

<sup>2/</sup> Personal communication.

public. Overnight camping areas have been provided in addition to several picnic units. Permits are sold for the hunting of mule deer. Tourism and tourist accommodations are continuing to receive emphasis, including urban parks, sport areas, and playgrounds.<sup>1/</sup>

#### ARCHEOLOGICAL AND HISTORICAL VALUES AND UNIQUE SCENIC AREAS 2/

The Zuni area of New Mexico is characterized by diverse and abundant archeological and historical resources which represent different patterns of adaptation ranging in age from several thousand years B.C. until the time of Spanish entry into the southwest.

The earliest manifestations of human activity in this area of New Mexico include evidence of a relatively long period of big game hunting as well as hunting and gathering adaptations. Following introduction of domesticated plants and development of sedentary life, further regional specialization occurred. Two somewhat different Puebloan manifestations eventually evolved in northwestern and west central New Mexico. The historic Zuni culture appears to have developed out of a Puerco-Chacoan base in the early Pueblo periods, and was more closely related to the Anasazi Pueblo development in the north. Later Zuni culture, however, appears to have been the product of influence from extensions of the Mogollon Pueblos to the south of Zuni.

While the northwestern area of New Mexico has been the focus of numerous archeological investigations, much of the work has centered around the more spectacular sites dating to the Puebloan periods. Less work has been done on earlier Basketmaker periods. Little is known regarding the nature of the relationships between the Zuni area itself and the other major developments in the southwest.

In order to provide factual information regarding the presence and significance of archeological resources in the area of the Oak Wash Dam Project, the Arizona State Museum, under contract with the National Park Service (Arizona Archeological Center), conducted an archeological survey of the project area during the months of July and August 1972. Three reports which discuss the results of this investigation are: (1) "Archeological Clearance Investigations, Bureau of Indian Affairs, Pueblo of Zuni, Zuni Indian Reservation, McKinley County, New Mexico--Final Report for Oak Wash Dam Project" by Dana Isham; (2) "Archeological Survey of the Proposed Right-of-Way for the Oak Wash Dam-Zuni River Pipeline" by Ric Windmiller; and (3) "Impact of the Oak Wash Dam Project on Archeological Sites near Zuni, New Mexico" by Ric Windmiller. These are available from the National Park Service.

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<sup>1/</sup> Zuni Comprehensive Development Plan, 1969.

<sup>2/</sup> Information furnished by National Park Service and Arizona State Museum, University of Arizona, Tucson, Arizona.



The survey revealed the presence of 19 archeological sites in the project area that range in cultural affiliation from Late Basketmaker to protohistoric. Functionally, these sites appear to represent a number of diverse activity areas ranging from seasonal occupation sites to sedentary pithouse villages. The sites also constitute a set of cultural and temporal manifestations never examined in detail in the Zuni area. Specific site descriptions are detailed in the report by Isham. Windmiller's report includes tables that summarize the general settlement types and time periods represented by the sites in the project area. Windmiller's report also includes a map showing site locations.

The National Register of Historic Places lists only two properties as National Register sites in McKinley County. Neither are in the vicinity of Zuni nor the Oak Wash Dam Project. While the possibility exists that Zuni Pueblo may eventually be nominated to the National Register, such action has not yet been taken.

#### SOIL, WATER, AND PLANT MANAGEMENT STATUS

The project area is furnished technical assistance through the Soil Conservation Service field office at Gallup, New Mexico, in cooperation with the McKinley Natural Resource Conservation District. There are about 240 operating units covering 100 percent of the watershed area under cooperative agreement with the McKinley NRCD. Conservation plans have been developed for the watershed area.

Proper grazing use has been applied on a portion of the watershed. In addition, some brush management has been carried out on areas of the watershed and a few small erosion control structures have been installed. Some labor and capital are being employed for crop production in the floodplain that covers a large portion of the irrigated agricultural lands. Presently, labor and capital are used to a small degree because most of the cropland in the floodplain is idle and not being farmed.

The constantly changing course of floodwater and sediment depositions from successive flood events and an inadequate supply of irrigation water has discouraged the Zuni farmers to the point that most of the irrigated land is idle. As recently as 1938, all the idle land in the northwest portion of the Zuni irrigation unit was in alfalfa.

## PROJECTS OF OTHER AGENCIES

There are no known existing or future water resource development projects that have a direct relationship to the works of improvement included in this project, except the planned enlargement of Black Rock Reservoir. Personnel of the Bureau of Indian Affairs are investigating alternative methods to provide additional storage for irrigation water. The additional irrigation water is needed to achieve full development of about 900 acres of cropland within the watershed that cannot be irrigated due to an inadequate source of supply.

A special flood hazard report has been completed by the Corps of Engineers, U.S. Army Engineer District, Los Angeles. The purpose of the report is to present information on the flood hazard along the Zuni River in the Pueblo of Zuni. The reach of the Zuni River studied in this report includes a section approximately 2-1/4 miles in length that begins about 1/4 mile east of Zuni High School. Land use in the floodplain is primarily agricultural; however, local officials anticipate substantial development in the future. Data in the report can be used as a basis for further planning toward optimum use and development of flood-prone areas. Such planning would include controlling the construction of buildings, constructing flood control projects, or by a combination of these and other methods of floodplain management.

The Pueblo of Zuni is currently carrying on an improvement program within the urban area. This program includes street and road improvements, internal drainage system, reorganization of the sanitary sewer system, and improvements to the utilities. In addition, the Pueblo is working on a water use plan and the development of a zoning ordinance, trading ordinance, and grazing code.

## WATER AND RELATED LAND RESOURCE PROBLEMS

### LAND TREATMENT

The watershed lands, as a whole, are very fragile and highly erodible, and much of the area is steeply sloping. Lack of adequate vegetation due to overuse by livestock and drought increases the area's susceptibility to erosion.

Sheet erosion and much gully erosion occur over a portion of the watershed area that needs erosion control in the form of small rock, log, net wire or other types of gully plugs. These need to be installed in most of the small water courses to reduce the velocity of the water. Debris basins or small earth structures with a pipe used as a principal spillway are needed in several of the main drainages.

Sagebrush composes about 45 percent of the vegetation over areas of the watershed. Sagebrush is not desirable in the present composition now found in the plant community and needs to be managed. This area would respond faster if reseeded to alkali sacaton and western wheatgrass in a mixture and deferred from grazing for a minimum of two years.

In other areas of the watershed, pinon and juniper compose approximately 10 to 15 percent of the ground cover. Some of these areas were chained in 1966 but the pinon and juniper are resprouting and need follow-up management and treatment. A large percentage of the resprouting is occurring from trees that were not completely uprooted in the first chaining operation. Brush management is needed on other pinon and juniper areas. Some of the areas will also need to be reseeded. More useful vegetation, providing multi-purpose benefits, can be established and maintained on these sites.

### FLOODWATER DAMAGE

Flooding, sediment deposition, and erosion are the major problems in the watershed. Oak Wash crosses the Zuni Irrigation Canal approximately one mile north of the Pueblo. The flows traverse the agricultural alluvial fan below the canal. The slopes of the alluvial fan are very flat which creates sediment deposition problems. The flows fan out in this area, resulting in flood-flows spreading over a large portion of the urban area of the Zuni Pueblo and the surrounding irrigated farm land.

Floods from high-intensity thunderstorms occur frequently. Damages occur almost every year as the fan-flow must traverse the agriculture fan and the urban fan before entering the Zuni River. Accounts of past floods obtained from local sources indicate that some of the more damaging floods occurred in 1922, 1924, 1946, 1958, 1963, 1964, 1965, 1967, 1969, and 1970. The storms occur mostly as high-intensity, short-duration summer thunderstorms. The resulting runoff is characterized by relatively large peaks with short-duration flows. Sediment yield is very high and may contribute as much as 50 percent to the peak discharge and volume of runoff. Due to the meandering of the overland fan-flow of floodwater, it is impossible to predict where flooding will occur from individual storms.

Flooding causes structural damage to homes and businesses and their contents in the Pueblo of Zuni. Water ponding from these floods creates health hazards from disease-carrying flies and mosquitoes, water stagnation, and sewage pollution. With the expanding population and limited high ground, new housing has moved onto the floodplain. The movement to the floodplain has increased the potential for flood damage. Floods from a storm having a one percent chance of occurrence will flood 151 acres in the Pueblo of Zuni, resulting in damage to 543 homes and to commercial establishments and utilities. Annual flood damage to homes will be \$131,240. Annual damages to commercial establishments and utilities contribute another \$11,040.



Floods damage irrigation delivery canals interrupting irrigation water delivery. These frequent floods interfere with the delivery of irrigation water from the main canal. If the canal is broken or silted up, the irrigation water must be turned off at Black Rock Reservoir, three miles above the intersection of the canal and Oak Wash. Even a small break may cause the irrigation water to be turned off for a week until the area dries out and equipment can be moved in. This interruption of irrigation water begins with a storm having a 10 percent chance of occurrence and affects about 666 acres of cropland. Repair of flood damage to the canal amounted to \$960 in 1969 and \$4,100 in 1970. Flood damage to the road along the canal averages \$500 per year.

About 1,440 acres of irrigated lands are subject to flooding. Based on present conditions, a storm having a one percent chance of occurrence could flood 782 acres of the irrigated land. The crops grown are alfalfa, corn, and garden vegetables. The estimated average annual floodwater damages to agriculture amount to \$3,860. The estimated damage from a one percent chance storm (100-year frequency) is \$520,000.

Flood damage and sediment damage from the 1970 storm is typical of damages incurred in the watershed. Official documented records of past floods are not available. Because of the lack of historical flood and precipitation data, hydrologic and meteorologic data were synthesized. This storm appears to have been approximately a 50-year event, and inundated a large area of the Pueblo of Zuni and about 400 acres of the surrounding agricultural lands. Based on synthesized data, it deposited approximately 390 acre-feet of sediment in the floodplain. The peak flow was approximately 6,000 cubic feet per second over the floodplain, resulting in depths of about 2.0 feet.

Flooding from the Zuni River occurs along the floodplain adjacent to the river. About 70 acres of the Zuni River floodplain is common with the Oak Wash floodplain. Storms resulting in damage from Oak Wash usually would be a separate storm from that causing damage from the Zuni River. Damage reduction benefits that will accrue to the common floodplain were not used as benefits for this project.

#### EROSION DAMAGE

Accelerated erosion is occurring in the uplands within the watershed. Erosion rates are high. The average annual gross erosion is estimated to be 8.8 acre-feet per square mile. Four percent of the watershed was found to be severely gullied, 34 percent suffers slight to moderate erosion, 33 percent suffers severe erosion, and 29 percent suffers geologic or minor erosion on shallow, rocky soils or bare rock. It is estimated that gully and streambank erosion is the source of 60 percent of the damaging sediment. The remaining 40 percent is from sheet and rill erosion. Minor scour damage

is occurring on fields near the channel where it flows onto the irrigated lands. Scour damage was not evaluated because it was not considered significant.

### SEDIMENT DAMAGE

Sediment from Oak Wash is deposited in the irrigation canal causing a maintenance problem. Accumulations of sediment fill the canal and cause the irrigation water and floodwater to break the canal banks.

Sediment spread over the cropland does not cause a long-term loss of productivity to the land. Besides the crop losses and damage to irrigation ditches, the heavy deposition of silt and fine sand on 421 acres disrupts irrigation grades and irrigation water management. The frequency of crop loss has discouraged the Zuni farmers. Fertilizers are not used for maintaining productivity.

Severe sediment damage occurs in the urban areas where sediment is deposited in homes, businesses, and on equipment. The sediment fines which settle in the Pueblo are later stirred by wind and traffic, causing severe dust conditions. The high rate of respiratory ailments among the Zuni Indians is significant.

Sediment from the watershed passes into the Zuni River floodplain and Tekapo Reservoir that is about six miles downstream from the Zuni Pueblo. Tekapo Reservoir provides water for irrigation and wildlife habitat. It is estimated that the watershed contributes an average of 43.5 acre-feet of damaging sediment to the Zuni River floodplain and croplands each year.

The average annual sediment damage for the future, without project conditions, is estimated to be \$15,440.

### IRRIGATION AND DRAINAGE

The irrigated lands are irrigated from a storage reservoir (Black Rock Reservoir). Presently, storage in the reservoir has been reduced by accumulation of sediment, and water is available to irrigate only 1,500 acres. It is estimated that approximately 95 percent of the irrigable land will be irrigated in the next 10 years. The additional water needed for irrigation will be made available through enlargement of Black Rock Reservoir. The existing irrigation systems are not adequate to provide good irrigation water management. Technicians from the Bureau of Indian Affairs are working with the people to plan for needed improvement in irrigation systems. Presently, 666 acres of the cropland are being irrigated.

### MUNICIPAL AND INDUSTRIAL WATER

Municipal water for the Pueblo is supplied by wells. This supply of water is adequate in quantity and quality. As the needs



increase with the population growth, additional wells can be developed.

### FISH AND WILDLIFE

Rangeland wildlife habitats have been damaged by erosion and reduction of plant species' diversity and abundance. These damages are attributed to past overutilization by domestic livestock, and to a lesser degree by the mechanical removal of trees and shrubs.

The rangeland habitats are deficient in abundance of preferred browse species needed for nutritious winter food supplies for mule deer. The limited herbage plant composition, further stressed by domestic grazing practices, fails to produce sufficient seeds during the winter months to support many resident scaled quail.

### ECONOMIC AND SOCIAL

Farm income on the Zuni Reservation is limited and it must be supplemented by off-farm employment in order to provide even a modest standard of living. Limited non-farm employment opportunities prevent many families from supplementing their farm income. Economic development has been hindered by several local problems having to do with conservation and development of land, water, and other related resources. These problems include limited monetary and human resources for planning and applying needed land treatment measures. Also, insufficient funds have delayed the construction for control measures of floodwaters from Oak Wash. Controlling floodwaters is a prerequisite to many of the urban developments within the Pueblo for providing employment opportunities.

The area has the unifying influence of a large Indian population. The Navajo Reservation encompasses a large portion of the area in the subregion. The average per capita income for the subregion is \$1,562 while the per capita income for the Pueblo of Zuni is \$906. The average per capita income for the United States is \$3,910. The Zuni Comprehensive Development Plan, dated July 1969, states, "The Pueblo is too poor to fully participate in the 'War on Poverty'".

### RELATIONSHIP TO LAND USE PLANS, POLICIES, AND CONTROLS

An application for assistance in developing the watershed under Public Law 566 was prepared in July 1969 by the Zuni Tribal Council and the McKinley Natural Resource Conservation District. This application covered two other major drainages in addition to Oak Wash. A preliminary investigation followed the application and was completed in November 1970. The investigation indicated that a feasible project could be developed under the provisions of Public Law 566 on Oak Wash. Little opportunity existed for

justification of treatment measures on the other two drainages. Authorization was granted May 24, 1971, to provide planning assistance to the sponsors for making investigations and surveys necessary to the development of this watershed work plan.

An initial formulation meeting was scheduled and held by the sponsors on June 15, 1971. This was a general formulation meeting for discussing the proposed watershed development, resource inventories, land treatment, environmental effects, structural measures, and other information.

The proposed project is compatible with the Zuni Comprehensive Development Plan completed in 1969. This plan includes flood control for Zuni Community as one of the major items to be accomplished. Each has a goal of reducing or eliminating flooding, sediment deposition, and erosion besides providing watershed protection. The effect of the project on flood flows and sediments in the Zuni River is not significant. Similar projects on many areas along the Zuni River would be needed to create a change large enough to be monitored.

The New Mexico air quality legislation and ambient air standards and regulations provide a regional approach to air pollution control as required by the Federal Amended Clean Air Act of 1970. Project action will not exceed the air pollution standards. Dust from road maintenance, traffic, and wind erosion from the structure sites will not increase greatly from present conditions because the areas will be kept moist. Noise pollution will be maintained within federal, state, and local standards, because equipment will be checked and monitored during construction.

## E N V I R O N M E N T A L   I M P A C T

### FLOOD PREVENTION, EROSION, AND SEDIMENT

Installation of land treatment practices such as proper grazing use, deferred grazing, livestock water development, and range seeding in the uplands will increase the vigor, stand, and productivity of forage plants. Continued treatment and improvement of the range-land resource in the watershed will create a demand for additional hay. These treatment practices are estimated to reduce erosion in the uplands by five percent. All cover improvements which result from this management will serve to lengthen the useful life of the floodwater retarding structure due to reduction in sediment yields that may occur.

Conservation treatment of irrigated land will result in more efficient use of irrigation water, reduce erosion, reduce nutrient loss, and make better use of rainfalls. Installation of land treatment practices such as conservation cropping systems, crop residue management, and pasture and hayland management will help protect the soil from

erosion by water and wind, and help to maintain the productivity of the soil for a sustained agriculture. The proper management of irrigation through better distribution facilities and methods of application will reduce waste of water.

These structural measures will not control the flooding along the Zuni River floodplain caused by the flood flows from the Zuni River. The floodplain of the Zuni River was determined by a study completed by the Corps of Engineers.

The structural measures included in this plan will reduce average annual floodwater and sediment damages resulting from the Oak Wash drainage area to the agricultural and urban land below the structure by 100 percent. The measures will control 94 percent of the contributing drainage area above the Zuni Irrigation Canal for storms ranging up to the 100-year event. The drainage area that is not controlled consists of 0.9 square miles above the irrigation canal and drains through the west side of the irrigated cropland. This drainage has been treated with debris basins that will store the 10-year sediment accumulation and control runoff up to the 10-year storm. The damage from this drainage area is negligible for all storms ranging up to the 100-year event and will affect only the cropland on the west side.

There will be approximately 0.75 square miles of drainage area below the floodwater retarding structure. This area will drain into the urban area of the Pueblo. The runoff from this area will be controlled by land treatment measures to be planned and installed after completion of the structural measures. The internal drainage system being installed by the Pueblo of Zuni in the urban area will provide some relief until land treatment measures are installed.

The floodwater retarding structure and associated outlet works only provide a level of protection up to the 100-year frequency storm. The structure is designed to safely pass the peak flow from the storm generated by the probable maximum precipitation. Flows begin to pass through the emergency spillway once the 100-year frequency is exceeded. In view of this limitation of the project, high damages and possible loss of life could result from a false sense of security. The Pueblo of Zuni will periodically bring this to the attention of the people. Even though damages occur from storms larger than the 100-year event some damage reduction would be realized from the works of improvements during these storms. One hundred and fifty-one acres within the Pueblo limits would be protected from a storm having a one percent chance of occurrence.

In addition, 543 families will benefit from reduced floodwater and sediment damage to their homes from a storm having a one percent chance of occurrence. Two hundred and twenty-one families would benefit from protection during a storm having a 20 percent chance of occurrence. In addition to the 543 homes, four commercial



businesses, two schools, a church, a mission, a school teacherage of 16 units, and the local jail will receive protection. With the project installed, the hazards to health and life are essentially eliminated.

The area benefited by the project also includes 1,440 acres of irrigated land. Protection provided to these lands from a storm having a one percent chance of occurrence will be an incentive to return 834 acres of idle irrigated land to production. This would also permit more intensive use of the 666 acres of irrigated land presently in production. An incentive would be provided to develop needed irrigation water for full utilization of an additional 900 acres of idle land. The project would prevent damage to the main irrigation canal alleviating interruptions and loss of irrigation water.

Based on synthesized data, the peak flow from a storm, equivalent to the 1970 storm, would be reduced to approximately 710 cubic feet per second. About 90 percent of the sediment yield from the watershed above the irrigation canal would be collected by the structure with about 4.3 acre-feet being delivered directly to the Zuni River. The concentration of sediment in the water delivered to the river is estimated to be 8,600 parts per million (p.p.m.). For all practical purposes, this is clear water and will not adversely affect the mainstream water quality.

#### FISH AND WILDLIFE

The construction of the floodwater retarding structure and the pipeline will temporarily disturb ecological functions on about 190 acres consisting of rangeland and cropland. This area will be lost for wildlife and agricultural uses until the embankment and disturbed areas are revegetated after construction.

Agricultural and wildlife use will be occasionally interrupted on the 280 acres used to store sediment and floodwater. The periodic inundation will provide additional effective moisture which will induce an improvement in vegetative composition and production, thus increasing food for both livestock and wildlife.

The project will cause more intensive land use on about 1,500 acres of irrigated land. Much of this acreage is expected to go into the production of hay. The effect will be an increase in perennial herbage, and a diversification of vegetable and small grain crops. Communities of wild animals will change, as will populations, but the net effect is expected to be an improvement in food supplies and permanent cover types available to resident and migratory species. Land treatments planned for the rangelands of the watershed will cause major changes in vegetative composition and diversity and will in turn influence communities of wild animals.

Since 1966 there have been about 1,700 acres of pinon and juniper cleared by mechanical methods. About 1,500 acres of this area will be recleared. An additional 1,200 acres of pinon-juniper or sagebrush will be cleared, some by hand cutting. The removal of these amounts of tree and shrub species will reduce the availability of nesting sites for some bird species. In addition, there will be a concurrent loss of tall cover available for escape or protection from the weather.

Improvements of perennial grasses will occur on about 850 acres of range seeding and 115 acres of pasture planting. Together with planned cross fencing and improvements in grazing management, these treatments will improve herbaceous composition and density over much of the rangeland. The addition of cool season grasses into the plant composition will improve the existing gap in early season forage availability. These treatments are expected to provide improved habitat conditions for scaled quail, and ground nesting and feeding songbirds. There will be a reduction in small rodents which will lead to fewer predatory species.

The general improvement in range forage conditions, together with improved management of livestock, will reduce the grazing intensity on the small mesas and breaks. These scattered areas, totaling 2,500 acres, are expected to show a favorable response in the growth and reproduction of browse plants. Improved production of browse will benefit mule deer.

While wildlife populations residing in the proposed construction areas are low, there will be a temporary disruption of normal activity during the periods of construction. Following completion of construction it is expected that wildlife populations will readjust to the carrying capacity of the new habitat. A potential hazard for a few small animals that may drown will be created when the detention pool fills rapidly.

#### ARCHEOLOGICAL, HISTORICAL, AND SCIENTIFIC<sup>1/</sup>

Archeological resources constitute a fragile record of previous human occupation, discernible only through carefully planned and professional excavation and analysis. Such resources are finite in number, and are non-renewable. Any alteration of the ground surface in and around archeological sites destroys context. In turn it reduces the amount and quality of information potentially available for future scientific and interpretive use.

One archeological site (ZOW 15) will immediately be destroyed by dam construction and a second site (ZOW 6) is near enough to be threatened by dam construction, and is low enough to be threatened

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<sup>1/</sup> This information furnished by the National Park Service and Arizona State Museum, University of Arizona, Tucson, Arizona.

by frequent flooding and runoff. Six sites (ZOW 4, 5, 11, 13, 14, and 19) lie below the 100-year flood line and will be subjected to long-term destruction by erosion, sedimentation, and periodic flooding. Three other sites (ZOW 12, 16, and 17) are situated below the maximum pool elevation and are exposed to potential flooding and erosion because of the dam. The remaining seven sites are located above the spillway level and will not be affected by the project. This cluster of 18 sites located in the dam area represents a significant settlement complex. The total complex must be considered as the resource to be affected by the dam.

The commitment of land for construction of the Oak Wash Dam will have direct effects upon the archeological resources in the project area that will be affected by construction or flooding. Any commitment of archeological resources, whether to construction, vandalism, or even mitigating salvage excavation, results in a net loss in the total amount of archeological information remaining for future study and interpretation.

### ECONOMIC AND SOCIAL

Based on average anticipated conditions, it is estimated the project would provide nearly 175 man-years of employment during the installation period. An undetermined amount of employment would also be generated in the production of secondary benefits subsequent to the installation of the project. Considering the anticipated eight-year project installation period and the average annual unemployment rate, it is estimated that unemployment could be reduced by an average of five percent annually. After completion, secondary benefits will continue to provide a low level of increased employment.

Agriculture is one of the predominant long-term economic bases of the area. The idle irrigated lands should be returned to production. The agricultural efficiency would be improved by the project. Crops could be planted with confidence at earlier dates. The need for replanting would be eliminated, thereby saving considerable added costs. Delayed harvesting would be eliminated and the risk of having to harvest immature crops due to the lateness in the season would be avoided. More efficient and increased use of fertilizer can be obtained. The surface of the fields would remain level, reducing wear and tear on machinery and saving maintenance costs. Improved efficiency of farm operations and improved farm income because of the project would provide incentive for full utilization of farm land.

Secondary benefits are those arising from the increased production of goods and services as a result of the project. They also include benefits induced by the project. The induced benefits are increased expenditures by people in the area. They are estimated to be 10 percent of direct damage reduction and annual operation and maintenance costs. The secondary effects will be significant in the subregion.



Intangible project benefits will be an opportunity to shift funds from repairing damages to investing in schools, libraries, and other facilities that improve the quality of living.

Other effects will be the creation of some noise and dust pollution during construction and disruption of the natural landscape by the earth structure.

#### FAVORABLE ENVIRONMENTAL EFFECTS

A. Elimination of flooding and associated damages in the Pueblo of Zuni leading to:

1. Upgrading of homes and businesses, creating better urban environment.
2. Release of public and private monies previously needed for repairs and maintenance to other beneficial uses.
3. Reduction of health hazards such as vector breeding areas and water contamination.
4. Reduction of travel and service interruptions.

B. Reduction of flooding and associated damages occurring from a 100-year storm on 1,440 acres of prime irrigated cropland leading to:

1. Preservation of soil resources.
2. Better use and conservation of irrigation water.
3. Retention of maximum option for future use.

C. Improvement of vegetative cover on uplands leading to:

1. Reduction of soil erosion by five percent.
2. Increased quantity and quality of livestock forage.
3. Improved forage for wild herbivorous and seed-eating wildlife.

D. Increased production and improved composition of rangeland and shrubland vegetation on about 280 acres will create a more desirable habitat for wildlife species. Flooding will periodically interrupt wildlife use of this area.

E. Creation of about 175 man-years of employment during construction. and the reduction of unemployment by about five percent.

F. Improvement of social and economic environment by increasing income and reducing costs of maintenance.

#### ADVERSE ENVIRONMENTAL EFFECTS

A. Temporary disruption of ecological functions on about 190 acres of rangeland and cropland.

B. Removal of some areas of brush in the upland which provide nesting and cover for birds and small animals.

C. Commitment of about 652 acres of rangeland and cropland to construction, operation, and maintenance of the floodwater retarding structure.

D. Creation of some noise and dust pollution during construction.

E. Creation of a potential hazard from drowning for small animals when the detention pool fills rapidly.

F. Increased use of fertilizers that will contribute to agricultural pollution.

G. Commitment of 11 archeological sites to mitigation salvage and excavation will result in a net loss in total amount of archeological information remaining for future study and interpretation.

#### A L T E R N A T I V E S

##### LAND TREATMENT ONLY

This alternative consists of applying land treatment on the rangeland. Land treatment would include proper grazing use, range deferred grazing, stockwater development, brush control, range seeding, and erosion control. The estimated cost for the land treatment is \$55,900.

This alternative would be beneficial in meeting the need for sustained and increased forage production. These practices will improve the ground cover, increase livestock forage production, improve the quality of forage, and increase food and cover for wildlife.

The land treatment program alone would not provide adequate treatment for significantly reducing runoff and sediment yields. Flooding through the irrigated agricultural lands and the Pueblo of Zuni would continue. This would tend to discourage farmers from completing land treatment systems for the irrigated cropland and pastureland. Approximately \$184,650 of the average annual damages occurring from floodwater would still occur. Flood damage



would still occur to 543 homes, 4 commercial buildings, 2 schools, 1 church, 1 mission, 1 school teacherage with 16 units, and the jail in the Pueblo. A potential hazard would remain for loss of life and to public utilities.

#### FLOODPROOFING AND ZONING WITH LAND TREATMENT

This alternative consists of establishing the limits of flooding for the 100-year flood and instituting zoning regulations for further planning toward optimum use and development of the flood-prone area. In addition, the existing developments would be floodproofed through the raising of foundations or some method of insuring that the developments were protected from potential damage. Land treatment would be applied on the rangeland portion of the watershed.

The present development in the 100-year floodplain would remain, and future improvements would be restricted to projects that would not contribute to the flooding problem nor be susceptible to flood damage. These types of improvements could be parking lots or recreation areas. Floodproofing to the 100-year level would cost approximately \$4,500,000 including costs for sediment removal and maintenance. This cost would be the responsibility of the landowners. All types of improvements would need to be floodproofed for water depths of about three feet. Protection would be provided to 543 homes, 4 commercial buildings, 2 schools, 1 church, 1 mission, 1 school teacherage with 16 units, and the jail. Positive control of floodwater and heavy sediment transports would not be realized. A potential hazard would remain for loss of life and to public utilities. The sediment deposition would create severe dust and air pollution when they dry out and begin to blow.

Since flooding through the irrigated agricultural lands would continue, the farmers would be discouraged from completing land treatment systems for the irrigated cropland and pastureland. Land treatment would be applied on the rangeland. This would include proper grazing use, range deferred grazing, stockwater development, brush control, range seeding, and erosion control. This land treatment would cost about \$55,900 and would improve the ground cover, increase livestock forage production, and increase food and cover for livestock.

#### FLOODWAY WITH LAND TREATMENT

This alternative consists of constructing a floodway to safely convey the flood flow from Oak Wash into the Zuni River. Land treatment would be applied on the rangeland and irrigated lands. The channel would be constructed around the Pueblo on the west side and empty into the Zuni River. The channel would be about 800 feet wide and 16,000 feet in length. It would require about 300 acres, of which 90 percent would be from the irrigated lands. A minimum five-foot dike would be required on each side to contain the flows. Large

concrete drop structures are needed to reduce the gradient to achieve a stable waterway. A large bridge would be needed to permit the flows to pass under State Highway 53. The estimated construction cost for this alternative is \$3,500,000. The estimated cost of the land treatment is about \$965,900.

Impacts resulting from this alternative include:

1. Reduction of flooding and associated damages occurring from a 100-year storm in the Pueblo of Zuni and to 1,140 acres of the surrounding irrigated cropland.
2. Improvement of vegetative cover on uplands leading to increased quantity and quality of livestock forage and improved forage for wildlife habitat.
3. Creation of about 175 man-years of employment during construction and the reduction of unemployment by about five percent.
4. Commitment of about 300 acres of irrigated cropland to construction, operation, and maintenance of the channel.
5. Creation of a potential hazard, especially to children, due to the channel being located in close proximity to the urban area of the Pueblo.
6. Increase in the sediment yield to the Zuni River.

#### NO PROJECT

This alternative would deprive the area of \$313,620 in benefits. Floodwater, erosion, and sediments would continue to damage urban and agricultural improvements. Farm operations would continue to be downgraded. Approximately 1,440 acres of floodplain would be without protection from floodwater and sediment. The vegetation or natural stream regime would not be disturbed. Other impacts would remain in their present conditions as described in the problems section.

The sponsors selected the floodwater retarding structure with land treatment. They considered this alternative to provide the framework of assistance for the full development and stabilization of the total resources and economy of the watershed. Multi-purpose objectives were considered to include storage for irrigation, fish, and wildlife. Development of the water budget revealed that the average annual evaporation will offset the average annual yield of runoff at the floodwater retarding structure site, measuring about 500 acre-feet. Therefore, the yield is not adequate to support multi-purpose objectives.

## SHORT - TERM VERSUS LONG - TERM USE OF RESOURCES

The sponsors have planned this project with due consideration for the preservation of natural resources and potential future developments.

The Pueblo of Zuni completed and adopted a Comprehensive Development Plan in July 1969. Zuni has its share of development needs like other communities, and there are project problems that relate to these needs. The single overall objective toward which the Pueblo of Zuni is working and planning is to "raise the level of living for residents of the Zuni Reservation to equal or exceed the average for all United States citizens". To achieve this objective, the following major goals have been set to guide the comprehensive program plan:

- A. Increase Individual Income.
- B. Enhance Educational Opportunity.
- C. Improve Living Conditions.

Installation of the project will provide flood protection to about 1,440 acres of agricultural land and 151 acres of urban land. This flood protection will permit the agricultural land to be more intensively used and/or developed for irrigation when water is available. This permits long-term use without deteriorating the land resource base. The urban flood protection will allow the residents to plan an upgrading of its facilities and services without the fear of damage from flooding and permit implementation of many other projects included in the comprehensive plan which are dependent on flood protection.

The goals will be greatly restrained without the protection from floodwater and sediment damage. Changes in land use have not been proposed which will significantly restrict future use or limit productivity. Proposed land treatment measures will meet the needs for sustained or increased productivity. The plan provides a level of protection consistent with the needs and objectives of present and anticipated use of the floodplain lands. The structural measures are evaluated for a 100-year period. At the end of this period, the floodwater retarding structure will continue to provide the designed level of flood protection. However, sediment accumulations will at this time begin to gradually decrease available flood storage. The structure would no longer provide storage in the sediment basin for supplemental irrigation. The sediment accumulation could be excavated on an annual basis after the sediment pool has filled to continue to provide at least the full designed level of flood protection. The cumulative effects of the projects in the region were considered, although a significant number of these effects are not anticipated.



## IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES

Installation of structural measures will require the commitment of 652 acres for land rights. This includes 642 acres of rangeland and 10 acres of cropland. The use of the 652 acres of land for installation and operation of the project will impose certain restraints on its future use. The land will be restricted to uses which will not interfere with the operation and maintenance of the structure or suffer significant property damage from temporary inundation. After the structural measures are installed, the future land use will remain the same as the present land use.

The construction of the Oak Wash Dam and the impoundment of water behind it will commit 11 of the archeological sites located by the Arizona State Museum to direct destruction in some degree. Of these, nine will not be affected by actual construction activities, but will be threatened by destruction following completion of the dam. Because archeological resources are finite in number and are non-renewable, the Oak Wash Dam project will therefore commit 11 archeological sites to eventual destruction. This will result in an irreversible and irretrievable loss in the total cultural resource base and a reduction in the amount of archeological and historical information remaining for scientific and interpretive study and use.<sup>1/</sup>

Other commitments of resources include labor, materials, and energy required for construction of the project.

## CONSULTATION AND REVIEW WITH APPROPRIATE AGENCIES AND OTHERS

### GENERAL

The application for assistance to the Zuni Pueblo Watershed by the McKinley Natural Resource Conservation District and the Pueblo of Zuni was approved by the New Mexico State Engineer for the State of New Mexico in 1969. A preliminary investigation completed in 1970 indicated that a feasible project could be developed. This investigation was made by the Soil Conservation Service with assistance from the Pueblo of Zuni, Bureau of Indian Affairs, and New Mexico State Engineer.

The project was authorized for planning in May 1971. An initial formulation meeting was scheduled and held by the sponsors on June 15, 1971. Notification of this meeting with an invitation to

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<sup>1/</sup> Information furnished by National Park Service and Arizona State Museum, University of Arizona, Tucson, Arizona.



attend and a request for information and suggestions were made to the following agencies:

Bureau of Indian Affairs, Bureau of Outdoor Recreation, U.S. Bureau of Reclamation, U.S. Forest Service, New Mexico State Highway Commission, New Mexico State Parks and Recreation, Farmers Home Administration, New Mexico Department of Public Health, U.S. Fish and Wildlife Service, New Mexico Department of Game and Fish, Four Corners Commission, U.S. Bureau of Mines, Bureau of Land Management, New Mexico State Planning Office, New Mexico State Engineer Office, and Agricultural Stabilization and Conservation Service. During the planning of the project, close cooperation was maintained with all these groups. Open meetings were held throughout the planning process to inform the public and to solicit ideas, suggestions, and alternatives.

The New Mexico State Engineer's Office provided information and assistance concerning the structural measures. The National Park Service and the Arizona State Museum provided assistance with the historical and archeological investigation.

The U.S. Fish and Wildlife Service and New Mexico Department of Game and Fish provided assistance with the investigations and analysis for fish and wildlife.

DISCUSSION AND DISPOSITION OF EACH  
PROBLEM, OBJECTION, OR ISSUE RAISED  
ON THE DRAFT ENVIRONMENTAL STATEMENT BY  
FEDERAL, STATE, AND LOCAL AGENCIES, AND  
PRIVATE ORGANIZATIONS AND INDIVIDUALS

Following is a list of the agencies that were requested to review and comment on the draft environmental statement:

Department of the Army  
Department of the Interior  
Department of Commerce  
Department of Health, Education and Welfare  
Department of Transportation  
Environmental Protection Agency  
Office of Equal Opportunity, U.S. Department of Agriculture  
Federal Power Commission  
Advisory Council on Historic Preservation  
New Mexico State Engineer (Governor's Representative)  
New Mexico State Planning Office (State Clearinghouse)  
New Mexico State Historic Preservation Office  
New Mexico Environmental Improvement Agency

The following agencies did not respond to the request for review and comments:

Department of Commerce  
Department of Health, Education and Welfare  
Office of Equal Opportunity, U.S. Department of Agriculture  
Federal Power Commission

The comments and the disposition of each are as follows:

Department of the Army, Los Angeles District, Corps of Engineers

Comment: The Chief of Engineers has also asked for our comments for inclusion in his reply to a similar request. His letter will include our comments.

Response: Noted.

Department of the Army, Office of the Assistant Secretary

Comment: We have reviewed the work plan and foresee no conflict with any projects or current proposals of this Department. We do suggest that since the reservoir routing for the Probable Maximum Event indicated some overtopping of the structure, that the Service consider, in view of its location above a residential area, whether the structure could fail as a result of this overtopping.

Response: The structure has been proportioned to safely pass the peak flow from the storm generated by the probable maximum precipitation as stated on page 31 of the work plan and on page 28 of the environmental impact statement. Flows will begin to pass through the emergency spillway once the 100-year frequency is exceeded.

Comment: The draft environmental impact statement is considered to be satisfactory insofar as this Department is concerned.

Response: Noted.

Department of the Interior

Comment: Work Plan

Although the National Park Service has requested funds for studies and salvaging (page 29, paragraph 3), the Soil Conservation Service should be prepared to finance the project should appropriations not be available to the National Park Service.

Response: This type of work will be accomplished with funds other than P.L. 566 monies.

Comment: Draft Environmental Statement

The project should have no significant effect on the availability or commitment of mineral resources.

Response: Noted.

Comment: The statement mentions, on page 5, that the project will not control flooding from the Zuni River. There are many unfavorable impacts from the flooding of the Zuni River, as noted on page 23, that will contribute to reduce project benefits. It appears that much of the damage will be averted through the project where, in reality, the Zuni River will continue to damage this area, thus reducing the suggested benefit of Oak Wash. These impacts should be addressed.

Response: Damages that occur in the common floodplain of Oak Wash and the Zuni River were not used as benefits for this project. This is explained in footnote 3, Table 5, page 44 of the Work Plan, and on page 24 of the environmental impact statement.

Comment: We note that land treatment and livestock management proposals are quite superficial. They are presented with little interest in actual implementation. It is also stated that anticipated land management practices will only reduce erosion five percent in the project area. It appears grass seeding and a two-year deferred program is the extent of the effort. Additional information to clarify the actual intent of these proposals is desired.

Response: The land treatment measures will be applied on Indian lands and state-leased lands in the combinations needed to achieve proper use and adequate treatment. This will be achieved by land operators through complete conservation plans with the McKinley Natural Resource Conservation District, as stated on page 5. Land treatment practices include, but are not limited to, proper grazing use, deferred grazing, livestock water development, brush management, range seeding, grade stabilization structures, debris basins, and fence construction. The entire watershed area of the floodwater retarding structure on Indian lands is planned to be and will be fenced for proper management.

Comment: The statement, as it pertains to the hydrology of the proposed project area, appears to be reasonably adequate and accurate in the evaluation of the environmental impact of the proposed action. The next to last sentence in the next to last paragraph on page 23 of the draft statement, dealing with sediment transport, is worded rather vaguely. We suggest this sentence be clarified.



Response: The sentence has been restated to read, "Sediment yield is very high and may contribute as much as 50 percent to the peak flow and volume of runoff."

Comment: The Zuni Tribe has a general plan for upgrading reservation resources and facilities. These future tribal resource plans should be related to the proposed SCS project and the impact analysis section should be expanded to include the associated impacts.

Response: The watershed plan is in harmony with and will enhance the Zuni tribe's plans for upgrading resources and facilities. These improvements are being installed by the Pueblo of Zuni. The information needed to fully assess the potential environmental effects of these improvements would probably require an environmental assessment directed to this effort. An assessment of the Pueblo of Zuni's improvements is not the intent of the assessment for the Zuni Pueblo Watershed project. The improvement program is being carried out under other than the authority of the Watershed Protection and Flood Prevention Act (P.L. 566, 83d Congress, 68 Stat. 666, as amended).

Comment: The stated alternatives are limited in number and each lacks an objective analysis. This section of the statement should be revised and expanded.

Response: On pages 33, 34, and 35, the statement on impact of viable alternatives has been expanded.

#### Department of Transportation, United States Coast Guard

The Department had no comment.

#### Environmental Protection Agency

Comment: It is expected that there will be some noise and dust pollution during construction (page 33). Any measures which could be used to lessen this pollution should be described in the statement. Also, there could be increased erosion in the project area during construction and before re-vegetation. Measures to be used to mitigate the potential impacts from erosion should be described in the statement.

Response: Measures that will be used to minimize pollution were described on page 9 of the draft environmental impact statement. The statement on page 9 has been modified and expanded to more clearly identify measures that will be taken to control pollution during construction.

Comment: We believe the alternative section could be strengthened by the inclusion of an objective presentation of the beneficial and adverse environmental effects of all possible



alternatives. Such a discussion would be helpful in evaluating the environmental effects associated with each alternative and the proposed project.

Response: On pages 33, 34, and 35, the impacts of alternatives evaluated have been expanded to clarify beneficial and adverse impacts of each.

Comment: On page 23 it is stated, "New housing has been built on the floodplain because of the lack of high ground and the expanding population, and this has increased the potential for flood damage." From page 31, "The secondary effects will be significant in the sub-region." We believe that consideration should be given to developing a land use plan (floodplain zoning) for the project area. Such a plan could help to minimize long-term adverse environmental effects and to ensure that future development in the Pueblo of Zuni would be consistent with the land use in adjacent areas. Additional information on this subject would strengthen the final statement.

Response: On page 22, information has been provided in the section on "Projects of Other Agencies" to identify actions being taken by the Pueblo of Zuni. The section, Short-Term Versus Long-Term Use of Resources, identifies that the Pueblo of Zuni has completed and adopted a Comprehensive Development Plan. The Development Plan, which is updated periodically, provides for the future development in the Pueblo. In addition to this information, the following sentence was included on page 22: "In addition, the Pueblo of Zuni is working on a water use plan and the development of a zoning ordinance, trading ordinance, and grazing code."

Comment: It is mentioned that the Pueblo of Zuni is undertaking an improvement program within the project area. The final statement should discuss the sanitary sewerage system and the internal drainage system in more detail. This should include the locations, capacities, and types of systems being installed. If there is to be an effluent discharged from either system, the quantity and quality of this effluent should be described in addition to an identification of the receiving stream. This information would be helpful in assessing the potential environmental effects of this program on the project area.

Response: The watershed plan is in harmony with and will enhance the Zuni tribe's plans for upgrading resources and facilities. The information needed to assess the potential environmental effects of the sanitary sewerage system and the internal drainage system would probably require an environmental assessment directed to this effort. Those improvements

are being installed by the Pueblo of Zuni. An assessment of the Pueblo of Zuni improvement is not the intent of the assessment for the Zuni Pueblo Watershed project. The improvement program is being carried out under other than the Authority of the Watershed Protection and Flood Prevention Act (PL-566, 83rd Congress, 68 Stat. 666, as amended).

State Engineer, State of New Mexico

Comment: This project will afford much needed protection to agricultural land and to the urban area in and around Zuni Pueblo. I support the Zuni Pueblo Watershed project and urge early approval for construction.

Response: Noted.

McKinley Area Council of Governments

Comment: Supported as written.

Response: Noted.

State Historic Preservation Officer, State of New Mexico

Comment: Enclosed is the State Archeologist's review of the draft environmental statement and work plan for the Zuni Pueblo Watershed project. We find his conclusions appropriate. Let me suggest that if mechanized equipment is used, it be done under the direct supervision of the Chief Project Archeologist. I agree with Mr. Peckham, however, when he says that mechanized equipment may do more harm than good.

Response: The statement on page 8 has been modified to state that the detailed archeological investigations will be carried out under the direct supervision of a qualified, professional archeologist.

Environmental Improvement Agency, State of New Mexico

Comment: We have reviewed the above-referenced plan and commend you on its excellence. We support your efforts, particularly as they relate to reduction of sediment entering the Zuni River. We do recommend that efforts be taken to control erosion during as well as after construction.

Response: Noted.

## Advisory Council on Historic Preservation

Comment: Pursuant to its responsibilities under Section 102(2)(c) of the National Environmental Policy Act of 1969, the Advisory Council has determined that the DES and WWP appear adequate concerning compliance with Section 106 of the National Historic Preservation Act of 1966. However, with respect to compliance with the provisions of Executive Order 11593, "Protection and Enhancement of the Cultural Environment" of May 13, 1971, the Council notes that the proposed undertaking will result in an adverse effect to numerous cultural resources which possess historical and/or archeological significance and therefore may be eligible for inclusion in the National Register of Historic Places.

To remedy this deficiency, the Council will provide substantive comments on the undertaking's effect on the previously mentioned cultural properties through the process for compliance with the "Procedures for the Protection of Historic and Cultural Properties".

Please contact Michael H. Bureman of the Advisory Council staff to assist you in completing this process as expeditiously as possible.

Response: The contact with Michael Bureman was made as recommended and coordinated with Mr. Thomas W. Merlan, State Historic Preservation Officer, State of New Mexico. Further recommendations were made to request assistance of Mr. Russell Mortensen, Director, Office of Archeology and Historic Preservation, National Park Service. This request has been made and coordinated through Mr. Merlan. The Soil Conservation Service will comply with Section 106 of PL 89-665; Executive Order 11593; and 36 CFR 800, Procedures for the Protection of Historic and Cultural Properties, prior to construction.





L I S T   O F   A P P E N D I C E S

Appendix A - Comparison of Benefits and Costs for Structural Measures

Appendix B - Project Map

Appendix C - Letters of Comment Received on Draft Environmental  
Statement

Appendix D - Report of Archeological Clearance Investigations

Appendix E - Archeological Survey of Proposed Right-of-Way for  
Oak Wash Dam - Zuni River Pipeline

Appendix F - Impact of Oak Wash Dam Project on Archeological Sites

Appendix G - Glossary

Appendix H - Common Plant Names

APPROVED BY

M. E. Strong  
Name and Title  
State Conservationist

DATE:

July 3, 1975



APPENDIX A - COMPARISON OF BENEFITS - COSTS FOR STRUCTURAL MEASURES  
Zuni Pueblo Watershed, New Mexico  
(Dollars)

Evaluation Unit	AVERAGE ANNUAL BENEFITS <sup>1/</sup>										Benefit Cost Ratio
	Damage Reduction	Intensive Land Use	More Agricultural	Changed Land Use	Redevelopment	Secondary	Total	Average <sup>2/</sup> Annual Cost			
1	184,650	17,540	30,600	55,470	25,360	313,360	213,100	1.5:1			
Project Administration:	--	--	--	--	--	--	20,610	--			
GRAND TOTAL	184,650 <sup>3/</sup>	17,540	30,600	55,470	25,360	313,620	233,710	1.3:1			

Date: June 1975

1/ Price base current normalized prices for cropland and pasture; 1975 prices for all other.

2/ Installation: 1975 prices amortized for 100 years at 5-7/8 percent interest.




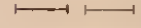





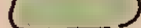
3/ In addition, it is estimated that land treatment installed in the watershed will provide \$200 average annual damage reduction benefits in the project area.

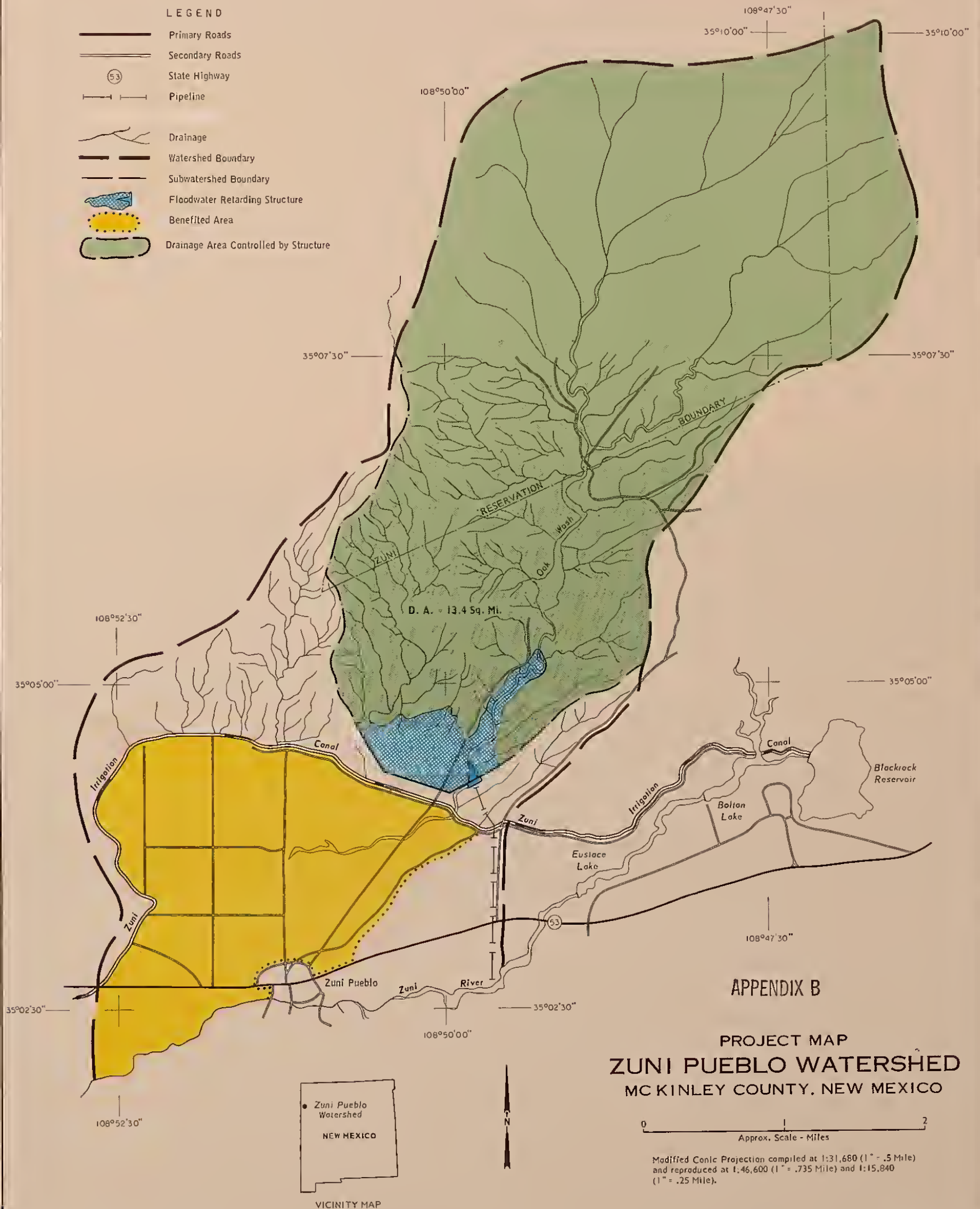






LEGEND

-  Primary Roads
-  Secondary Roads
-  State Highway
-  Pipeline
-  Drainage
-  Watershed Boundary
-  Subwatershed Boundary
-  Floodwater Retarding Structure
-  Benefited Area
-  Drainage Area Controlled by Structure

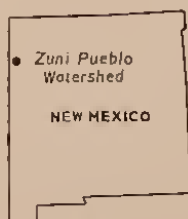


APPENDIX B

PROJECT MAP  
ZUNI PUEBLO WATERSHED  
MC KINLEY COUNTY, NEW MEXICO

0 1 2  
Approx. Scale - Miles

Modified Conic Projection compiled at 1:31,680 (1" = .5 Mile)  
and reproduced at 1:46,600 (1" = .735 Mile) and 1:15,840  
(1" = .25 Mile).



VICINITY MAP



APPENDIX C

Letters of Comment Received  
on  
Draft Environmental Statement







DEPARTMENT OF THE ARMY  
LOS ANGELES DISTRICT, CORPS OF ENGINEERS  
P. O. BOX 2711  
LOS ANGELES, CALIFORNIA 90053

AIRMAIL

SPLED-WB

14 April 1975

Mr. Marion E. Strong  
Acting State Conservationist  
Soil Conservation Service  
Box 2007  
Albuquerque, New Mexico 87103

Dear Mr. Strong:

This is in reply to your letter of 3 March 1975 requesting comments on the draft work plan and environmental statement for the Zuni Pueblo Watershed, New Mexico.

The Chief of Engineers has also asked for our comments for inclusion in his reply to a similar request. His letter will include our comments.

Sincerely yours,

A handwritten signature in dark ink, reading "Garth A. Fuquay", is positioned above the typed name.

GARTH A. FUQUAY  
Chief, Engineering Division





DEPARTMENT OF THE ARMY  
OFFICE OF THE ASSISTANT SECRETARY  
WASHINGTON, D.C. 20310

*Yours Sincerely*

Control No.  
*03-97906-G*  
Filed to:  
Date: *SCS*  
C MAY 20 1975

Honorable Robert W. Long  
Assistant Secretary of Agriculture  
Washington, D. C. 20250

Dear Mr. Long:

In compliance with Section 5 of Public Law 566, 83d Congress, the views of the Secretary of the Army were requested for the Watershed Work Plan and Draft Environmental Impact Statement for the Zuni Pueblo Watershed, New Mexico.

We have reviewed the work plan and foresee no conflict with any projects or current proposals of this Department. We do suggest that since the reservoir routing for the Probable Maximum Event indicated some overtopping of the structure, that the Service consider, in view of its location above a residential area, whether the structure could fail as a result of this overtopping.

The draft environmental impact statement is considered to be satisfactory insofar as this Department is concerned.

Sincerely,

*Charles R. Ford*

Charles R. Ford  
Deputy Assistant Secretary of the Army  
(Civil Works)







# United States Department of the Interior

OFFICE OF THE SECRETARY  
WASHINGTON, D.C. 20240

PEP ER-75/210

MAY 20 1975

Dear Mr. Strong:

Thank you for your letter of February 28, 1975, requesting our views and comments on the work plan and draft environmental statement for Zuni Pueblo Watershed, McKinley County, New Mexico. We believe the documents adequately portray the project and the associated environmental impacts upon outdoor recreation opportunities, fish and wildlife resources, and geological conditions. Specific comments are presented below.

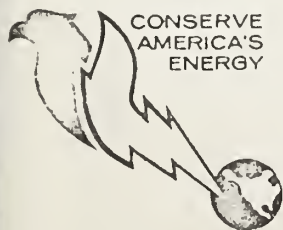
## Work Plan

The proposed action will not adversely affect any existing or proposed unit of the National Park System nor any site eligible for registration as a National Historic, Natural, or Environmental Education Landmark. Although the National Park Service has requested funds for the studies and salvaging (page 29, paragraph 3), the Soil Conservation Service should be prepared to finance the project should appropriations not be available to the National Park Service.

## Draft Environmental Statement

The watershed contains no existing mineral extraction operations and is not believed to be highly prospective for uranium, petroleum, natural gas liquids, natural gas, coal, clays, stone, or sand and gravel, which are produced in other parts of McKinley County. The project should have no significant effect on the availability or commitment of mineral resources.

The statement mentions, on page 5, that the project will not control flooding from the Zuni River. There are many unfavorable impacts from the flooding of the Zuni River, as noted on page 23, that will contribute to reduce project benefits. It appears that much of the damage will be averted through the project where, in reality, the Zuni River will continue to damage this area, thus reducing the suggested benefit of Oak Wash. These impacts should be addressed.



*Save Energy and You Serve America!*

We note that land treatment and livestock management proposals are quite superficial. They are presented with little interest in actual implementation. It is also stated that anticipated land management practices will only reduce erosion five percent in the project area. It appears grass seeding and a two-year deferred program is the extent of the effort. Additional information to clarify the actual intent of these proposals is desired.

The statement, as it pertains to the hydrology of the proposed project area, appears to be reasonably adequate and accurate in the evaluation of the environmental impact of the proposed action. The next to last sentence in the next to last paragraph on page 23 of the draft statement, dealing with sediment transport, is worded rather vaguely. We suggest this sentence be clarified.

The Zuni Tribe has a general plan for upgrading reservation resources and facilities. These future tribal resource plans should be related to the proposed SCS project and the impact analysis section should be expanded to include the associated impacts.

The stated alternatives are limited in number and each lacks an objective analysis. This section of the statement should be revised and expanded.

We hope these comments will be of assistance to you in preparing your final documents.

Sincerely yours,

A handwritten signature in dark ink, appearing to read "Stanley A. Scremus". The signature is fluid and cursive, with the first name "Stanley" being more legible than the last name "Scremus".

Deputy Assistant Secretary of the Interior

Mr. Marion E. Strong  
State Conservationist  
Soil Conservation Service  
Department of Agriculture  
Post Office Box 2007  
Albuquerque, New Mexico 87103



DEPARTMENT OF TRANSPORTATION  
UNITED STATES COAST GUARD

MAILING ADDRESS:  
U.S. COAST GUARD (G-WS/73)  
400 SEVENTH STREET SW.  
WASHINGTON, D.C. 20590  
PHONE: (202) 426-2262

• MAR 24 1975

Mr. Marion E. Strong  
State Conservationist  
Soil Conservation Service  
Box 2007  
Albuquerque, New Mexico 87103

Dear Mr. Strong:

This is in response to your letter of 28 February 1975 addressed to Commandant, U. S. Coast Guard concerning the draft environmental impact statement for the Zuni Pueblo Watershed, McKinley County, New Mexico.

The Department of Transportation has reviewed the material submitted. We have no comments to offer nor do we have any objection to the project.

The opportunity to review this draft statement is appreciated.

Sincerely,

W. E. CALDWELL  
Captain, U.S. Coast Guard  
Deputy Chief, Office of Marine  
Environment and Systems  
By direction of the Commandant





ENVIRONMENTAL PROTECTION AGENCY  
REGION VI  
1600 PATTERSON, SUITE 1100  
DALLAS, TEXAS 75201

April 21, 1975

OFFICE OF THE  
REGIONAL ADMINISTRATOR

Mr. Marion E. Strong  
State Conservationist  
Soil Conservation Service  
Box 2007  
Albuquerque, New Mexico 87103

Re: D-SCS-G36014-NM

Dear Mr. Strong:

We have reviewed the Draft Environmental Impact Statement and Watershed Work Plan for the Zuni Pueblo Watershed Project, McKinley County, New Mexico. The project is planned for watershed protection and flood prevention in the Oak Wash drainage area above the Zuni Irrigation Canal. The plan provides for the use of land treatment measures on 11,700 acres and the construction of one single-purpose floodwater-retarding structure with associated outlet works.

The following comments are for your consideration in preparing the Final Environmental Impact Statement:

1. It is expected that there will be some noise and dust pollution during construction (page 33). Any measures which could be used to lessen this pollution should be described in the statement. Also, there could be increased erosion in the project area during construction and before revegetation. Measures to be used to mitigate the potential impacts from erosion should be described in the statement.

2. We believe the alternatives section could be strengthened by the inclusion of an objective presentation of the beneficial and adverse environmental effects of all possible alternatives. Such a discussion would be helpful in evaluating the environmental effects associated with each alternative and the proposed project.

3. On page 23 it is stated, "New housing has been built on the floodplain because of the lack of high ground and the expanding population, and this has increased the potential for flood damage." From page 31, "The secondary effects will be significant in the sub-region." We believe that consideration should be given to developing a land use plan (floodplain zoning) for the project area. Such a

plan could help to minimize long-term adverse environmental effects and to ensure that future development in the Pueblo of Zuni would be consistent with the land use in adjacent areas. Additional information on this subject would strengthen the final statement.

4. It is mentioned that the Pueblo of Zuni is undertaking an improvement program within the project area. The final statement should discuss the sanitary sewerage system and the internal drainage system in more detail. This should include the locations, capacities, and types of systems being installed. If there is to be an effluent discharged from either system, the quantity and quality of this effluent should be described in addition to an identification of the receiving stream. This information would be helpful in assessing the potential environmental effects of this program on the project area.

These comments classify your Draft Environmental Impact Statement as LO-2. Specifically, we have no objections to the project; however, more information is needed in order to evaluate fully the project's long-term environmental effects. The classification and the date of our comments will be published in the Federal Register in accordance with our responsibility to inform the public of our views on proposed Federal actions, under Section 309 of the Clean Air Act.

Definitions of the categories are provided on the attachment. Our procedure is to categorize our comments on both the environmental consequences of the proposed action and on the adequacy of the impact statement at the draft stage, whenever possible.

We appreciate the opportunity to review the Draft Environmental Impact Statement, and we will be happy to discuss our comments with you. Please send us two copies of the Final Environmental Impact Statement at the same time it is sent to the Council on Environmental Quality.

Sincerely yours,

*George J. Petrusicki*  
for Regional Administrator

Enclosure

## ENVIRONMENTAL IMPACT OF THE ACTION

### LO - Lack of Objections

EPA has no objections to the proposed action as described in the draft impact statement; or suggests only minor changes in the proposed action.

### ER - Environmental Reservations

EPA has reservations concerning the environmental effects of certain aspects of the proposed action. EPA believes that further study of suggested alternatives or modifications is required and has asked the originating Federal agency to re-assess these aspects.

### EU - Environmentally Unsatisfactory

EPA believes that the proposed action is unsatisfactory because of its potentially harmful effect on the environment. Furthermore, the Agency believes that the potential safeguards which might be utilized may not adequately protect the environment from hazards arising from this action. The Agency recommends that alternatives to the action be analyzed further (including the possibility of no action at all).

## ADEQUACY OF THE IMPACT STATEMENT

### Category 1 - Adequate

The draft impact statement adequately sets forth the environmental impact of the proposed project or action as well as alternatives reasonably available to the project or action.

### Category 2 - Insufficient Information

EPA believes the draft impact statement does not contain sufficient information to assess fully the environmental impact of the proposed project or action. However, from the information submitted, the Agency is able to make a preliminary determination of the impact on the environment. EPA has requested that the originator provide the information that was not included in the draft statement.

### Category 3 - Inadequate

EPA believes that the draft impact statement does not adequately assess the environmental impact of the proposed project or action, or that the statement inadequately analyzes reasonably available alternatives. The Agency has requested more information and analysis concerning the potential environmental hazards and has asked that substantial revision be made to the impact statement. If a draft statement is assigned a Category 3, no rating will be made of the project or action, since a basis does not generally exist on which to make such a determination.





Advisory Council  
On Historic Preservation

U.S. Department of the Interior  
Washington, D.C. 20008

MAR 25 1975

Mr. Marion E. Strong  
State Conservationist  
Soil Conservation Service  
U.S. Department of Agriculture  
P. O. Box 2007  
Albuquerque, New Mexico 87103

Dear Mr. Strong:

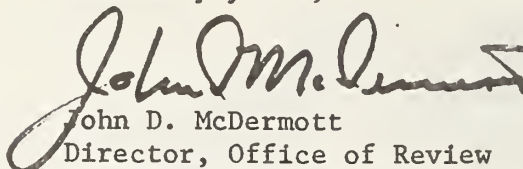
This is in response to your request of February 28, 1975 for comments on the draft environmental statement (DES) and watershed work plan (WWP) for the Zuni Pueblo Watershed, McKinley County, New Mexico. Pursuant to its responsibilities under Section 102(2)(C) of the National Environmental Policy Act of 1969, the Advisory Council has determined that the DES and WWP appear adequate concerning compliance with Section 106 of the National Historic Preservation Act of 1966. However, with respect to compliance with the provisions of Executive Order 11593 "Protection and Enhancement of the Cultural Environment" of May 13, 1971, the Council notes that the proposed undertaking will result in an adverse effect to numerous cultural resources which possess historical and/or archeological significance and therefore may be eligible for inclusion in the National Register of Historic Places.

Section 800.4(a) of the Council's "Procedures for the Protection of Historic and Cultural Properties" (36 C.F.R. Part 800) which sets forth steps for compliance with the Executive Order 11593, specifies the method of evaluating the historical and/or archeological significance of such properties. A copy of those procedures is enclosed for your convenience. If this evaluation results in a determination by the Secretary of the Interior that the property is eligible for inclusion in the National Register, then Soil Conservation Service must request Council comments in accordance with Section 800.4(e) of the procedures.

Until the requirements of Executive Order 11593 are met, the Council considers the draft environmental statement to be incomplete in its treatment of historical, archeological, architectural and cultural resources. To remedy this deficiency, the Council will provide substantive comments on the undertaking's effect on the previously mentioned cultural properties through the process for compliance with the "Procedures for the Protection of Historic and Cultural Properties."

Please contact Michael H. Bureman of the Advisory Council staff to assist you in completing this process as expeditiously as possible.

Sincerely yours,

  
John D. McDermott  
Director, Office of Review  
and Compliance

Enclosure



STATE OF NEW MEXICO

STATE ENGINEER OFFICE

SANTA FE

S. E. REYNOLDS  
STATE ENGINEER

BATAAN MEMORIAL BUILDING  
STATE CAPITOL  
SANTA FE, NEW MEXICO 87501

March 18, 1975

Mr. Marion E. Strong  
State Conservationist  
Soil Conservation Service  
Post Office Box 2007  
Albuquerque, New Mexico 87103

Dear Marion:

Your February 28, 1975 letter requests comments on the Zuni Pueblo Watershed Work Plan and draft environmental impact statement.

This project will afford much needed protection to agricultural land and to the urban area in and around Zuni Pueblo. I support the Zuni Pueblo Watershed Project and urge early approval for construction.

Sincerely,

S. E. REYNOLDS  
State Engineer

By

A handwritten signature in cursive script, appearing to read "Fred", written over a horizontal line.

F. R. Allen, Chief  
Technical Division

FRA:h1







# STATE PLANNING OFFICE

EXECUTIVE — LEGISLATIVE BUILDING  
SANTA FE 87503

CIELA (GRACE) OLIVAREZ  
STATE PLANNING OFFICER

JERRY APODACA  
GOVERNOR

ROBERT S. LANDMANN  
DEPUTY STATE PLANNING OFFICER

April 28, 1975

Mr. Marion E. Strong  
State Conservationist  
Soil Conservation Service  
Box 2007  
Albuquerque, New Mexico 87103

Dear Mr. Strong:

The State Planning Office has received the Draft Environmental Impact Statement on the Zuni Pueblo Watershed and offers the following comments:

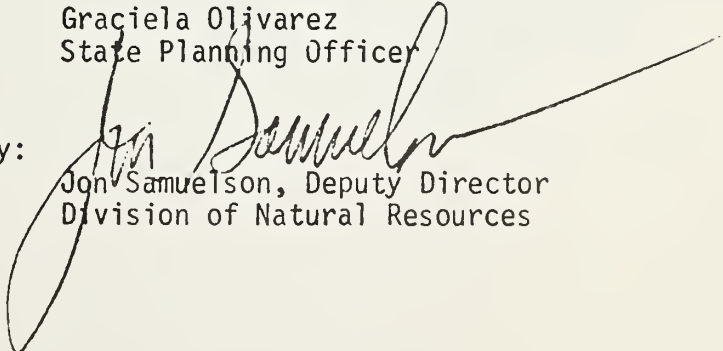
The environmental impact section of the statement includes a total of twelve pages briefly covering broad categories of flood prevention, erosion, sediment, fish and wildlife, archeological resources and economic and social resources. I notice that the total project construction costs approach \$4 million and a yearly operation and maintenance cost of over \$233,000. I don't believe that written pages are a measure of adequacy on environmental review, but I would suppose that a project costing millions of dollars would require substantial investigation on its environmental impact.

I would suggest that a more "in depth" investigation be carried out on future watershed work plans. The Department of Interior, U.S. Geological Survey publication, A Procedure for Evaluating Environmental Impact is an excellent tool and provides a good starting point. If this Office can be of any help, please let us know.

Sincerely,

Graciela Olivarez  
State Planning Officer

By:

  
Jon Samuelson, Deputy Director  
Division of Natural Resources

JS:Anne





APR 11 1975  
REC/P  
FAC  
SEN  
RES. COM

# STATE PLANNING OFFICE

EXECUTIVE - LEGISLATIVE BUILDING  
SANTA FE 87503

March 11, 1975

Mr. Marion E. Strong  
State Conservationist  
U. S. Department of  
Agriculture  
Soil Conservation Service  
Box 2007  
Albuquerque, New Mexico 87103

Dear Mr. Strong:

Enclosed is the State Archeologist's review of the draft Environmental Impact Statement and Work Plan for the Zuni Pueblo Watershed Project. We find his conclusions appropriate. Let me suggest that if mechanized equipment is used, it be done under the direct supervision of the chief project archeologist. I agree with Mr. Peckham, however, when he says that mechanized equipment may do more harm than good.

Let me know if you need any further information.

Sincerely,

Graciela Olivarez  
State Planning Officer

By: *Thomas W. Merlan*  
Thomas W. Merlan, State  
Historic Preservation  
Officer

TWM:jcl

Enclosure







MUSEUM OF NEW MEXICO, P.O. BOX 2087, SANTA FE, NEW MEXICO 87501

March 7, 1975

Mr. Thomas W. Merlan  
State Historic Preservation Officer  
New Mexico State Planning Office  
State Capitol  
Santa Fe, New Mexico 87503

Dear Mr. Merlan:

I have reviewed the Draft Environmental Impact Statement and Work Plan in terms of the archaeological values that may be affected by the Zuni Pueblo Watershed Project proposed by the Soil Conservation Service.

The reports and recommendations rightly indicate that archaeological work in the Zuni area has been neither extensive nor recent, and that the sites found in the project area are of sizes, types, and periods not studied by previous purely research-oriented programs. All 19 of the sites recorded are small, and most appear to have been constructed as seasonally-occupied dwellings close to agricultural areas. Presumably, their occupants lived in larger villages elsewhere during the rest of the year.

Eleven of the sites found are recommended for some degree of excavation. Of these, all but three are within the maximum pool area; the remainder are immediately adjacent to it. The Work Plan recommendations differ somewhat from the original survey proposals in that fewer sites are proposed for excavation. The recommendations for excavation of the sites, recovery of archaeological materials, and contributions to knowledge pertaining to Zuni heritage are all in the interest of the goals of both State and Federal historic preservation programs and should be approved.

The only part of the proposal that I question is the use of mechanized equipment to expedite the excavations. Several years ago, the National Park Service used a backhoe on some sites on a highway project east of Zuni. The results were far from satisfactory. Shallow architectural features were damaged, and, in one instance, a deeply buried structure was not even noticed. From the descriptions of the Watershed Project sites, they are likely to be of relatively shallow depth, and the use of a backhoe or road grader on them might lead to loss of more archaeological material and information than is recovered. If qualified archaeologists

Mr. Thomas W. Merlan


(2)

March 7, 19

conduct the excavations, and if they have proposed adequate labor forces, the amount of data and materials recovered from these fragile sites can be maximized without mechanical equipment.

I hope that all phases of the work will be used to provide experience for the young Zuni people who are currently participating in an archaeological training program at Zuni.

Sincerely,

A handwritten signature in cursive script, reading "Stewart L. Peckham". The signature is fluid and elegant, with the first letters of each word being capitalized and prominent.

Stewart L. Peckham,  
Curator in Charge  
Laboratory of Anthropology

SLP:jg



Environmental  
Improvement  
Agency

Water Quality Division - Directors Office  
P.O. Box 2348  
Santa Fe, NM 87503  
  
(505) 827-2473

February 14, 1975

Marion E. Strong  
United States Department of Agriculture  
Soil Conservation Service  
Box 2007  
Albuquerque, NM 87103

RE: Draft Work Plan Zuni Pueblo Watershed


Dear Mr. Strong:

We have reviewed the above referenced plan and commend you on its excellence. We support your efforts, particularly as they relate to reduction of sediment entering the Zuni River. We do recommend that efforts be taken to control erosion during as well as after construction.

Attached for your information are copies of related water quality management basin plans which have been prepared by our planning office pursuant to the Federal Water Pollution Control Act of 1972, PL 92-500, Section 303e. These plans are being developed for the entire state and copies will be sent to you as they are developed.

Thank you very much for the opportunity to comment.

Sincerely yours,

  
Aaron Bond  
Director

AB:DGH:nr

Enclosures: Lower Colorado River Basin Plan  
Western Closed Basin Plan







**McKINLEY AREA  
COUNCIL of GOVERNMENTS  
MACOG**

**JEFF MEYER  
EXECUTIVE DIRECTOR**

**PHONE: (505) 722-4327  
300 WEST HILL, SUITE 2  
GALLUP, NEW MEXICO 87301**

**A PARTNERSHIP FOR PROGRESS**

**PROJECT SUMMARY**

**PROJECT TITLE:**

Zuni Pueblo Watershed  
Environmental Impact Statement (Draft)

**APPLICANT AGENCY:** Pueblo of Zuni

McKinley Natural Resource Conservation District  
Northwest New Mexico Resource Development Project Area

**AMOUNT REQUESTED:**

\$4,827,000      \$3,644,500 - P.L. 566 Funds  
\$1,182,500 - SCS-BIA

**PROJECT PERIOD:**

8 years

**DESIGNED PROJECT AREA:** 20 Square miles 12,786 acres

Zuni Indian Reservation (58%)  
State of New Mexico (42%)

**DESCRIPTION OF PROGRAM:** (Stated objectives and activities)

The plan proposes that land treatment measures be accomplished on 11,700 acres of the Zuni Pueblo Watershed and one single-purpose floodwater retarding structure with associated outlet works be constructed during an 8 year installation period.



MCKINLEY AREA COUNCIL OF GOVERNMENTS

Consent & Approval Sheet

DATE REVIEWED: March 6, 1975

SAI 4

MAGOG 4

PROPOSAL REVIEWER: McKinley Area Council of Governments - Staff

PROJECT TITLE: Zuni Pueblo Watershed Environmental Impact Statement

APPLICANT: Pueblo of Zuni - McKinley Natural Resource Conservation District  
Northwest New Mexico Resource Development Project Area.

REMARKS:  
Supported as written.



McKinley Area Council of Governments

Comment & Review Sheet

Date Reviewed: April 4, 1975

SAI #                     

MACOG #                     

Proposal Reviewer: MACOG Physical Development and Environmental Concerns  
Committee

Project Title: Zuni Pueblo Environmental Impact Statement (Draft)

Applicant: Pueblo of Zuni - McKinley Resource Conservation District - Northwest  
New Mexico Resources Development Project Area.

COMMENTS:

Supported as written.





ARIZONA STATE MUSEUM  
UNIVERSITY OF ARIZONA

ARCHAEOLOGICAL CLEARANCE INVESTIGATIONS  
BUREAU OF INDIAN AFFAIRS, PUEBLO OF ZUNI  
ZUNI INDIAN RESERVATION  
McKINLEY COUNTY, NEW MEXICO

Final Report

for

OAK WASH DAM PROJECT

Prepared by: Dana Isham  
Supervisory Archaeologist

Submitted by: James E. Ayres  
Associate Archaeologist  
Arizona State Museum  
University of Arizona  
Tucson

September 14, 1972

NPS CONTRACT NO. 4940P20960



ABSTRACT: An archaeological survey was conducted between July 26 and August 4, 1972 of the proposed Oak Wash Dam site by members of the Zuni Archaeological Training Program. The survey was requested by the BIA, Resources Dept, Zuni Pueblo, in order to ascertain the archaeological impact for the dam site proposal. The investigations disclosed 19 prehistoric sites in or adjacent to the dam and reservoir areas.

On July 26, 1972 the Oak Wash Dam survey began. The survey was requested by the BIA, Resources Dept, Pueblo of Zuni. The survey was conducted by Dana Isham, Supervisory Archaeologist, and 5 Zuni trainees, participating in the Zuni Archaeological Survey and Training Program. The Zuni Archaeological Program, initiated on June 10, 1972 is directed toward the clearance and survey of proposed areas where construction is planned and the training of Zuni men in the basics of Archaeological survey.

The proposal for the Oak Wash Dam was done by the Soil Conservation Service in cooperation with the Four Corners Regional Commission, the BIA, and the Pueblo of Zuni, under a joint funding arrangement. The Oak Wash Dam is included as part of the Zuni Pueblo Watershed Project. The construction of the dam will be under the direction of the Soil Conservation Service. Oak Wash Dam, to be funded under the Flood Prevention Act, Public Law 566, is scheduled to be presented to Congress in July, 1973, with the actual construction of the dam expected the following year.

The Oak Wash area consists of foothills and floodplain caused by the erosion of higher mesas in the immediate area. The water control under consideration would include Oak Wash and numerous small drainages in the NW sector of the survey. Instances of arroyo cutting are frequent. The foothill area is covered with small junipers while the lower sections are open with shrubs and annual grasses predominating.

#### ARCHAEOLOGICAL RESOURCES

The Oak Wash Dam survey contained approximately 1100 acres. The survey included the proposed dam, an outlet works to the southeast, and all the reservoir area up to the high-water line.

The method of marking the sites was by flagging the perimeter. In addition, a stake with the site number written on it was placed at the approximate center of the archaeological site.

Archaeological survey disclosed 19 prehistoric areas. The sites include a burial ground, a water control structure, a shrine, the ruins of numerous 1-3 room structures, and sherd and lithic areas. The pottery dates from Late Basketmaker III through Pueblo V and recent times.

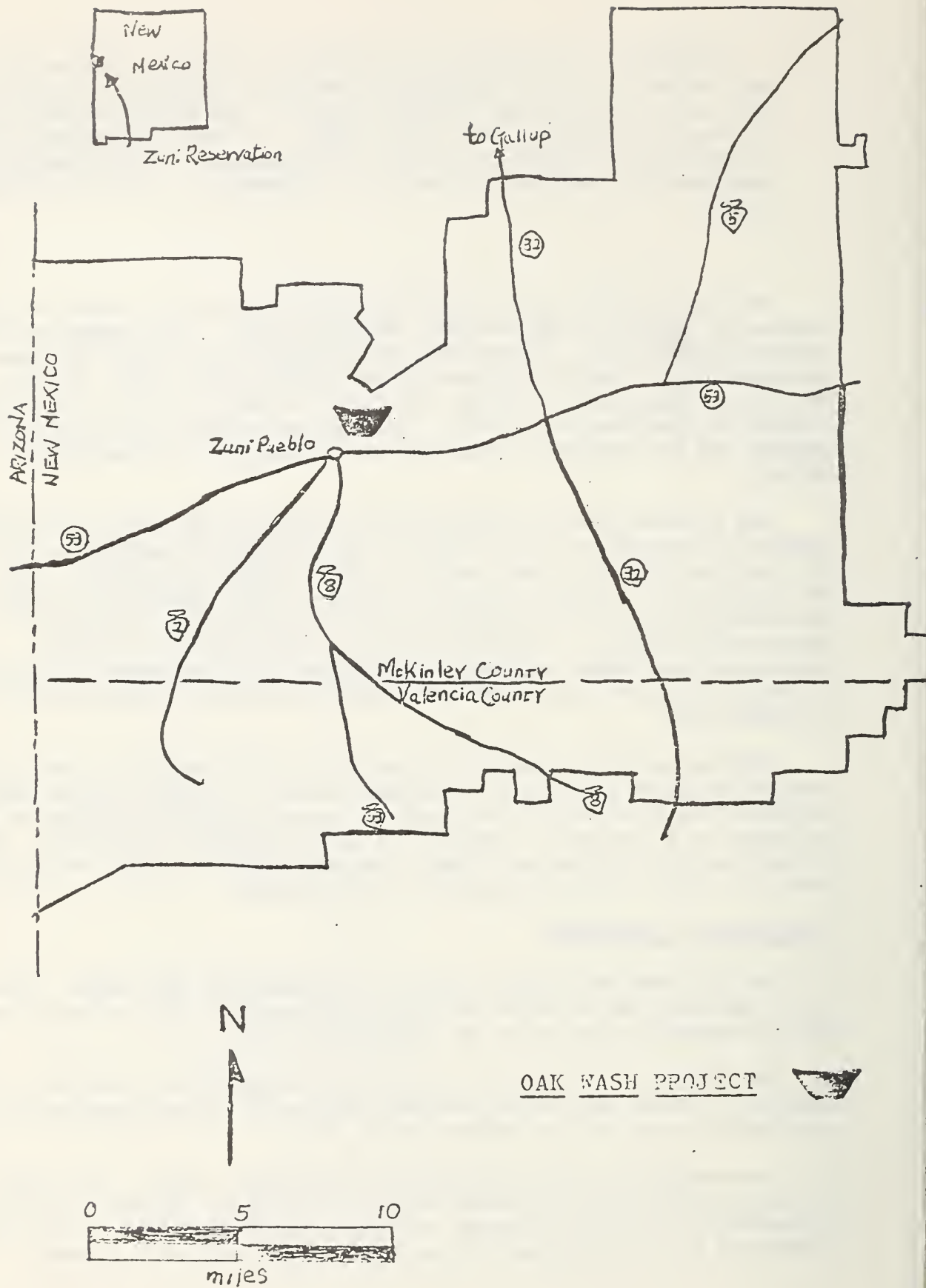
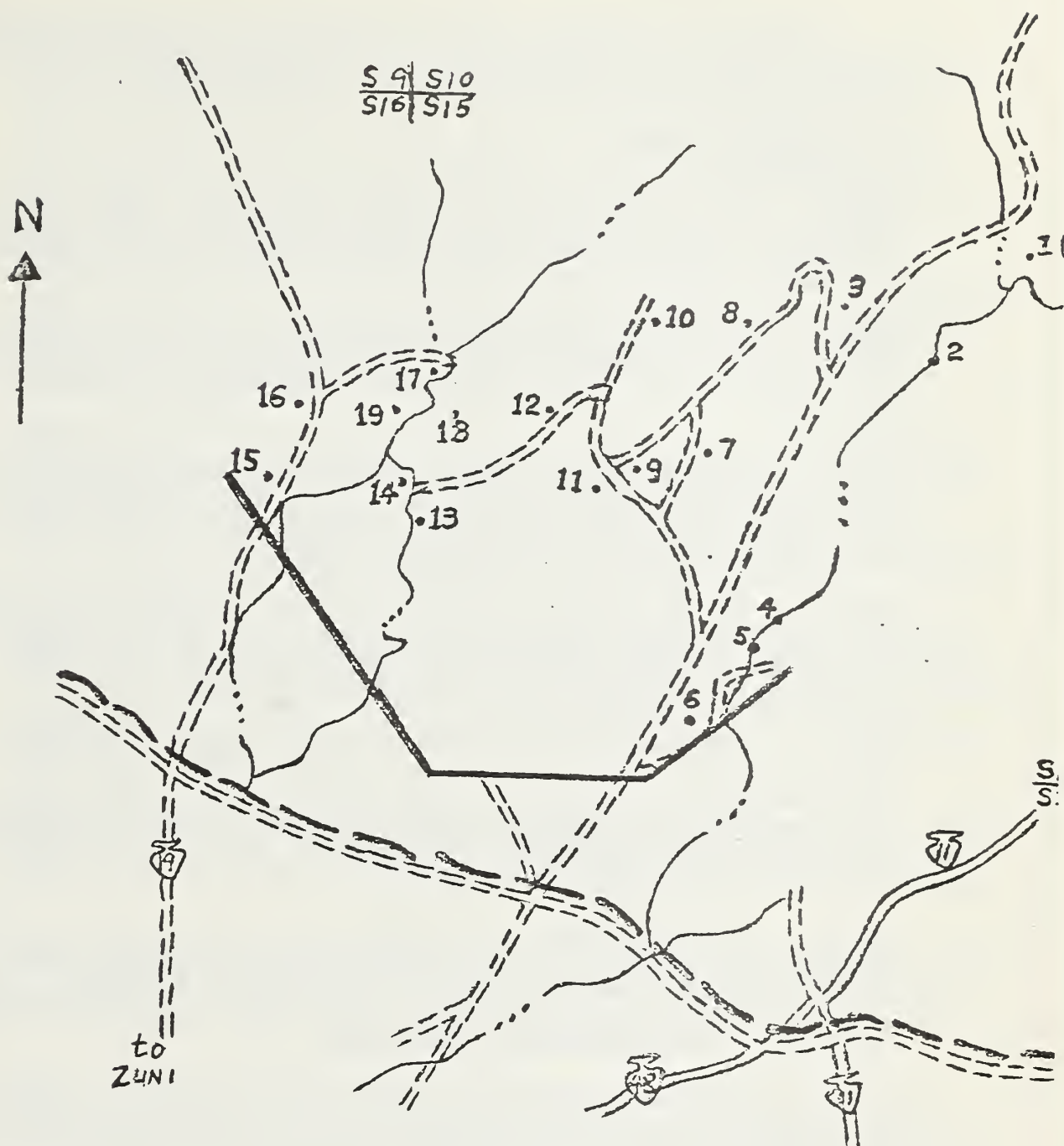


Figure 1  
-2-





SYMBOLS

- ===== unimproved dirt roads
- ~~~~~ streams
- irrigation ditch
- proposed dam site

0 1/4 1/2  
MILES

Figure 2

Three of the sites may not be affected by the proposed dam (ZOW-3, ZOW-8, ZOW-10). All other sites will be affected by the construction of the dam and will need further investigation and salvage.

#### DESCRIPTION OF SITES

ZOW-1 Site is located on a flat point above the west bank of Oak Wash. It lies about 25 feet east of the road and is covered with red, shaley sandstone. This site is a widely scattered sherd area that dates in the Pueblo II period.

ZOW-2 Located on the west bank of Oak Wash, this site lies about 50 feet from the center of the wash and 150 feet east of the road. There is a small storage structure and sherd area. The pottery is Pueblo II and Pueblo IV.

ZOW-3 A sherd and lithic area is located about 600 feet NNW of ZOW-2 upon the southeast side of the hill. This site spreads over both sides of the road. The pottery is Pueblo II and Pueblo IV. This site lies above the highwater line of the proposed dam.

ZOW-4 About 375 feet east of the road and in the west bank of the wash is a sherd area and evidence of a structure. The structure consists of 7 - 8 upright slabs oriented north-south about 10 feet in length. The pottery runs from Late Pueblo I through Early Pueblo III.

ZOW-5 Approximately 500 feet south of ZOW-4, again in the bank of the wash, is another sherd area and possible structures. This site is also the location of a recent trash dump. Above the trash dump in the bank is the evidence of a badly disintegrated human skeleton. Very fine pieces of charcoal were found mixed with the bones. The pottery is of Late Pueblo I and Pueblo II categories.

ZOW-6 Five hundred feet south of ZOW-5, well above the bank of the wash and west of the road, is a small rise where structures and a sherd area were found. There is scattered modern trash in the area. Large pieces of abalone shell were found at this site. The pottery consists of Pueblo I and Early Pueblo II varieties.

ZOW-7 Just above the right fork of the road and ENE of the sheep camp is a mound of rocks that was possibly a 3 - 4 room structure with accompanying sherd area. The pottery indicates Late Pueblo I and Pueblo II times.

ZOW-8 This site consists of three different mounds of rocks and sherd areas. The site is located north along the road above ZOW-7. The wooden stake marking the site is located on one of the ruins. From this ruin, the other two mounds are located to the north and NNW. Each mound suggests a 2 - 3 room structure. Pottery ranges from Pueblo I through Early Pueblo III time periods. This site lies above the high-water line of the proposed dam.

ZOW-9 Site is located on and to the left of a prominent hill covered with much red sandstone. Approaching the site, the road crosses what might be a water control structure. This structure consists of two lines of rocks that form a right angle 25 feet left of the road. The feature extends 130 feet at 43 degrees NW and at 51 degrees NE. The NW extension of this line ends above an arroyo cut. A sherd area was found here. The NE line of rocks connects to the hill. Just above the NE end of this feature is evidence of structures and a sherd area. Upright slabs and surface lines indicates a possible 1 - 2 room structure. Since no pottery was found around the line of rocks itself, test excavation will be needed to determine the relationship between this and the two sherd areas and structures. Potsherds suggest dates from Late Pueblo I through Early Pueblo III.

ZOW-10 This site is located upon a long sloping hill about 1200 feet north of ZOW-9. It lies to the right of the road about 350 feet. This site contains much scattered evidence for structures. Below the structures on the top of the hill, is a large broken pot and burnt area. This could be a cremation. A Pueblo II date for the pottery is suggested. This site lies above the high-water line of the proposed dam.

ZOW-11 Located at the sheep camp, two small mounds of rocks with sherd areas are to be found just west of the buildings. Further south about 100 feet is a well, old baking oven, and the ruins of a historic building. Sherds were found here. There is the possibility that the historic structure was built on top of older ruins. The pottery is of Pueblo II and Pueblo V time periods.

ZOW-12 On the SW slope of the hill behind the peach orchard, is a sherd area. The site lies about 100 feet SE of the road. There are abundant rocks but no structural evidence could be found. The pottery is Pueblo II.

ZOW-13 Reaching the east bank of the wash along the road, this site lies to the south across the fence about 25 feet. Sherds were found in and above the bank of the wash. The pottery is of Pueblo II and Pueblo V age. This site might be an extension of ZOW-14.

ZOW-14 Crossing the wash, ZOW-14 is a mound of rocks 100 feet to the right of the road. This mound is just above the west bank of the wash. This would seem to be a 1 - 2 room structure but no sherds were found here. Sherds were found to the north this side of the dam and across the wash on the east bank. There are also possible structures on the east side. The pottery types were Pueblo I and Pueblo II.

ZOW-15 On the west end of the large dam is a hill that the road passes over. On the NE end of this hill is the ruins of a one room structure. A few sherds were found filtering down the north slope below the ruins. Pueblo II and Pueblo V pottery were found here.



ZOW-16 This site encompasses a large area beginning with a small hill covered with large boulders. Among the boulders is a formation that suggests a possible shrine. Across the wash to the east and SE are two widely scattered sherd areas. Many lithics were in the sherd areas. Also, across the wash from the hill and about 200 feet to the NE, is a possible grave. The pottery ranges from Late Basketmaker III to Early Pueblo III.

ZOW-17 At the mouth of the canyon just below the peach orchard, at the top of the bank, is an exposed burial. Potsherds were found in and around this burial. The skeleton is remarkably well-preserved but is falling into the wash as more of it is exposed. Upright slabs of sandstone suggest the presence of 5 more burials. There are two recent petroglyphs in the rocks just below the cliff about 150 feet north of the burial. Pueblo II pottery was found at this site.

ZOW-18 A sherd area above the west bank of the wash 20 feet below a recent rock quarry. The site is about 700 feet ESE of ZOW-17. The pottery was Pueblo II and Pueblo III.

ZOW-19 A mound of rocks 300 feet north of the eastern end of the large dam. Structures are evident. At the north end of this mound is a 10 feet wide circular depression. Only five sherds were found here but this is in the immediate reservoir area. The pottery was Pueblo III.

## APPENDIX E

### ARCHAEOLOGICAL SURVEY OF THE PROPOSED RIGHT-OF-WAY FOR THE OAK WASH DAM - ZUNI RIVER PIPELINE

On March 3, 1973, an archaeological site survey was conducted by Ric Windmiller for the Arizona State Museum along the proposed right-of-way for the Oak Wash Dam - Zuni River Pipeline. The survey was conducted under the provisions of National Park Service Purchase Order No. PX810030098. The area surveyed extends for about 2 miles from the future site of Oak Wash Dam, across several fields, and follows Vandervagen Road to the Zuni River.

No archaeological or historic remains were found within the proposed right-of-way. It is recommended that archaeological clearance be given for the area within the right-of-way for construction of the pipeline. However, it is suggested that since the Zuni area is rich in both archaeological and historic remains, that care be exercised so as not to destroy such remains that may occur near the right-of-way.

Prepared By:

Ric Windmiller  
Supervisory Archaeologist  
Arizona State Museum  
University of Arizona  
Tucson, Arizona  
March 7, 1973





IMPACT OF THE OAK WASH DAM PROJECT ON ARCHAEOLOGICAL  
SITES NEAR ZUNI, NEW MEXICO

Prepared by:

Ric Windmiller  
April 23, 1973

Submitted by:

James E. Ayres  
Associate Archaeologist  
Arizona State Museum

NPS CONTRACT NO. 4940P20960



# IMPACT OF THE OAK WASH DAM PROJECT ON ARCHAEOLOGICAL

## SITES NEAR ZUNI, NEW MEXICO

This brief evaluation of archaeological remains within the proposed Oak Wash Dam Project area near Zuni, New Mexico, is the second of two reports concerning sites in this specific area. The first report, Archaeological Clearance Investigations for the Bureau of Indian Affairs, Pueblo of Zuni, New Mexico (Isham 1972), presented an inventory of cultural resources that will be affected by construction and subsequent filling of the proposed reservoir and recommended further investigation of these remains. The present paper is the result of a re-evaluation of the archaeological remains that will be either directly or indirectly affected by the construction and eventual flooding of the reservoir. Although 12 out of a total of 19 archaeological sites that were recorded during the original survey by Isham (1972) are situated within the maximum pool area of the proposed reservoir, all of the sites are recommended for further investigation because of their significance as a group. Those outside of the maximum pool area, but located adjacent to the shoreline, may become easily accessible and subject to vandalism that is presently non-existent. For this reason, all of the sites recorded should be considered as sustaining at least some devastating impact from the construction of the dam.

### Significance of the Archaeological Resources

The initial survey of the Oak Wash Dam area revealed the existence of 19 archaeological sites ranging in time from late Basketmaker III (c. A.D. 500-700) to proto-historic periods, based on a preliminary analysis of pottery sherds recovered from the surface (a final analysis of the pottery recovered from archaeological surveys within the project area is not yet completed). Functionally, the sites probably represent loci of diverse activities ranging from seasonally-occupied field houses to pit-house villages, although much discussion of settlement types must remain partly speculation until excavation is undertaken. Table 1 summarizes the general settlement type(s) represented at each site and time period(s) during which the sites were occupied, based on the preliminary pottery sherd analysis and surface indications of architectural remains.

John B. Rinaldo, in his brief paper on Origins of Historic Zuni Culture (1964), summarizes archaeological work that has been done in the Zuni region as basically surface surveys and some limited excavation that has resulted in the establishment of chronologies and trait lists that suggest general movements of people since the advent of puebloan life after A.D. 700. It is currently understood that early puebloan periods in the Zuni area (*i.e.*, Pueblo I through Pueblo III) were characterized largely by a culture that was Puerco-Chacoan in appearance. Pottery styles represented are those such as Kiatuthlanna Black-on-white, Red Mesa Black-on-white, and Puerco Black-on-white, Gallup variety, while architecture during the early pueblo periods can be classed broadly as

Chacoan. Both great kivas and smaller circular kivas have been excavated in the Zuni area by Roberts (1932) and Hodge (1923; also see Smith, Woodbury and Woodbury 1966). The evidence points strongly toward more than superficial similarities between the Zuni and Chaco areas during the early periods of Anasazi pueblo developments. However, after Pueblo III, the Zuni area appears to come under strong influence from the Mogollon area to the south and west. The change is evidenced particularly by the replacement of circular kivas by rectangular kivas and the advent of black-on-white and black-on-red polychrome pottery executed in styles reminiscent of Tularosa wares. Many of these elements of Mogollon origin apparently continued into proto-historic Zuni culture. It is quite possible, from the evidence that Rinaldo has amassed, that there was indeed a movement of Mogollon-related peoples into the Zuni area during sometime after Pueblo III, although much further investigation is needed to discern the nature of the movement (if any), or the nature of trade and other kinds of exchange that may have led to a strong Mogollon flavor to cultural developments in the Zuni area during late prehistoric and early historic times.

Although no large town sites of Puebloan periods were recorded during the survey within the Oak Wash Dam Project area, the types of settlements that appear to be represented reflect a considerable time depth and diversity of function. The sites dating to Basketmaker III times reflect a period of occupation in the Zuni area that is little known. A brief review of the literature indicates that little or no work in Basketmaker sites has been carried out in this region. In his review of archaeological research on Cebolleta Mesa, situated about 50 miles northeast of the Zuni area, Dittert reveals that no excavation of pithouse villages dating to this period has been carried out (1959:524). Surface surveys and limited excavation within the Zuni area (cf., Danson 1957, Kroeber 1916, and Spier 1917) have revealed the existence of pithouse villages, although only a few excavations have resulted and these occurring in the Vernon area of east-central Arizona some miles distant (Martin and others 1962). Excavation of later sites in the Zuni region (cf., Roberts 1932, Woodbury 1956, Woodbury and Woodbury 1956, and Smith and others 1966) have focused entirely on large spectacular sites, omitting small ruins such as field houses and small villages. Early in the history of archaeological work in the Zuni area, Cushing pursued some excavation in an attempt to outline the origins of historic Zuni culture. Later, Frederick Webb Hodge, following similar research objectives, led an expedition for the purpose of excavating Hawiku--one of the proto and early historic Zuni villages. Since the time of Hodge's expedition during the late teens and early twenties of this century, excavation has focused mainly on stratigraphic tests designed to gain some idea of pottery sequences and chronology of the area. This early work formed the backdrop for subsequent excavation by Roberts (1932) in the Village of the Great Kivas, and later the Woodburys at El Morro (1956). Recently, Watson and Redman have carried out investigations at another large village on the Zuni Reservation, but results of the excavation have not yet appeared in print.



Site No.	Settlement Category	Period
ZOW 1 (N. Mex. G:13:19)	Small village (?)	Pueblo II
ZOW 2 (N. Mex. G:13:20)	Storage structure (?)	Pueblo II and IV
ZOW 3 (N. Mex. G:13:21)	Field houses	Pueblo II and IV
ZOW 4 (N. Mex. G:13:22)	Small village (?)	Late Pueblo II through early Pueblo III
ZOW 5 (N. Mex. G:13:23)	Small village (?)	Late Pueblo I-Pueblo II
ZOW 6 (N. Mex. G:13:24)	Small village and historic trash	Pueblo I and early Pueblo II and Historic
ZOW 7 (N. Mex. G:13:25)	Small village	Late Pueblo I & Pueblo II
ZOW 8 (N. Mex. G:13:26)	Small village and adjacent field houses	Pueblo I through early Pueblo III
ZOW 9 (N. Mex. G:13:27)	Small village with compound wall	Late Pueblo I through early Pueblo III
ZOW 10 (N. Mex. G:13:28)	Large village and historic graves (?)	Pueblo II
ZOW 11 (N. Mex. G:13:29)	Historic rooms, oven and well; prehistoric field houses	Pueblo II, Pueblo V and Historic
ZOW 12 (N. Mex. G:13:30)	Small village	Pueblo II
ZOW 13 (N. Mex. G:13:31)	Field houses	Pueblo II and Pueblo V
ZOW 14 (N. Mex. G:13:32)	Field house	Pueblo I and II
ZOW 15 (N. Mex. G:13:33)	Field house	Pueblo II and V
ZOW 16 (N. Mex. G:13:34)	Scattered field houses, pit-house village (?) and shrine	Basketmaker III-early Pueblo III
ZOW 17 (N. Mex. G:13:35)	Small village (above-ground rooms), graves, possible pithouse village	Pueblo II
ZOW 18 (N. Mex. G:13:36)	Campsite (?)	Pueblo II and III
ZOW 19 (N. Mex. G:13:37)	Field house	Pueblo III

TABLE I. Archaeological sites recorded within and peripheral to the maximum pool area of proposed Oak Wash Dam. Settlement categories of sites are based on observation of surface remains and may not be entirely representative of actual settlement types extant in the Oak Wash area. Period of occupation of each site is based on a preliminary analysis of pottery sherds recovered from the surface. Sites are listed by field number and followed by Arizona State Museum designations in parentheses.

Thus, it can be seen that although some excavation has been carried out in the general region, information on Basketmaker sites as well as presumably seasonally-occupied field houses and small villages of the later periods is lacking. Because pottery types found during the survey by Isham (1972) are not available in summary form, this preliminary evaluation of significance of archaeological remains within the Oak Wash Dam Project area hinges mainly on the fact that little work has been afforded the early villages and later seasonally-occupied and presumably limited use sites. Also, there has been little focus up to now on reconstructing lifeways within the aforementioned categories of settlements. The sites within the Oak Wash Dam area have just this potential. A detailed reconstruction of past lifeways within sites and comparison of all of the sites both time- and space-wise will reveal a picture of cultural dynamics in the Zuni area that has not received attention to date. The sites within the reservoir area contain information significant to the reconstruction of much of prehistoric puebloan life outside of the spectacular town or large village sites. And, sites dating to late Basketmaker contain information critical to the reconstruction of this little-known period in the Zuni area. In short, loss of these archaeological resources either through flooding of the reservoir, construction of haul or other access roads, vandalism caused by improved accessibility or development around the perimeter of the maximum pool area, would result in an irretrievable loss of non-renewable resources that could add much to our knowledge of both protohistoric and prehistoric Indian groups in the vicinity.

Although a significant part of the importance of these archaeological sites lies in the area of scientific value, they are nonetheless valuable from the point of view of the heritage of the Zuni people. As such, these sites cannot easily be measured in monetary terms other than those indicated for their excavation and analysis, but can be evaluated in terms of their place in the past of the local people and other indigenous peoples of the Southwest who have received influence from the Zuni region in the past. An adequate understanding of this past, from a humanistic point of view, will undoubtedly lead to a better appreciation of this part of our heritage than that which exists at present. Destruction of the sites in the Oak Wash area without adequate study of their contents would not only be a loss to the scientific community, but will contribute directly to a failure in appreciation of this part of our past - a part that is not renewable and once destroyed, is lost forever.

#### A Program for Mitigating Adverse Effects

During the archaeological survey of the Oak Wash vicinity, sites were located that will be within, and outside of, but adjacent to the maximum pool area. Table 2 summarizes the location of these sites for the purpose of segregating them, as priorities for excavation are developed, should the Oak Wash Dam Project be continued.

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Sites located within the maximum pool area:

ZOW 4	(N. Mex. G:13:22)
ZOW 5	(N. Mex. G:13:23)
ZOW 6	(N. Mex. G:13:24)
ZOW 11	(N. Mex. G:13:29)
ZOW 12	(N. Mex. G:13:30)
ZOW 13	(N. Mex. G:13:31)
ZOW 14	(N. Mex. G:13:32)
ZOW 15	(N. Mex. G:13:33)
ZOW 16	(N. Mex. G:13:34)
ZOW 17	(N. Mex. G:13:35)
ZOW 18	(N. Mex. G:13:36)
ZOW 19	(N. Mex. G:13:37)

Sites located peripheral to the maximum pool area:

ZOW 1	(N. Mex. G:13:19)
ZOW 2	(N. Mex. G:13:20)
ZOW 3	(N. Mex. G:13:21)
ZOW 7	(N. Mex. G:13:25)
ZOW 8	(N. Mex. G:13:26)
ZOW 9	(N. Mex. G:13:27)
ZOW 10	(N. Mex. G:13:28)

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TABLE 2. Archaeological sites situated within and adjacent to the maximum pool area of proposed Oak Wash Dam.

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Assuming that the construction of the Oak Wash Dam is essential to a program of soil conservation in the Zuni area, there is no alternative to saving information embodied by the affected archaeological sites other than a program of excavation by qualified personnel. Since a program of excavation designed to recover all conceivable kinds of information that would not only be of use in current archaeological problem-solving but applicable to research goals that may become important in the future is not feasible in terms of expenditure of both time and finances, a program has been formulated that would sample each site adequately enough to gain ideas about the structure of social relations that were carried on there and interrelations on a social level between sites.

A detailed research design is omitted here in favor of presenting a brief outline of the kinds of techniques that should be involved in retrieving data for the purposes mentioned above. Basically, the excavation process should include exposure and recording of occupation surfaces (both within rooms and outside rooms in possible ramada areas), architectural and related features, and other material manifestations that



would allow for a development of ideas about the ways in which the former occupants interacted within a given settlement. The techniques used should also be applied to gaining ideas of the former entire structure of rooms and ramada areas through studies of room fill and overburden in outdoor living areas, respectively. Comparison of these material remains and reconstruction of social life between settlements preclude accurate measurement of dating so that such comparisons may show both how patterns of social interaction were arranged within a single time period and how they changed through time. Here, it is recommended that tree-ring and archaeomagnetic dating be used in addition to pottery seriation. The end result of work in the Oak Wash area should lead to a fairly good idea of what kinds of activities were carried on, by whom, and during which particular time periods. The results may well lead to some generalizations about cultural dynamics that could be of vital concern to the much broader area of anthropological knowledge, above that of a reconstruction of local prehistory.

#### A Preliminary Budget

Both testing and extensive excavation are recommended as an initial step in mitigating the adverse effects resulting from the construction of Oak Wash Dam (Table 3). Since all of the sites recorded are significant as a group with regard to answering some of the questions vital to an understanding of prehistoric and historic societies in the Zuni region, all are recommended for excavation. However, seven out of a total of 19 sites recorded are recommended for initial testing prior to establishing a budget for adequate excavation because their extent could not be determined from surface indications alone. In one case, a small site (ZOW 18, N. Mex. G:13:36) could not be relocated for the purpose of evaluation for inclusion in the present paper and is not included in the following budget figures. Because of recent erosion, it is quite possible that this site has been affected by a tributary of Oak Wash which has contributed to its obfuscation during the field evaluation.

It is recommended that the seven sites indicated for testing be the initial concern of any excavation program and that the resulting budgets for each (after the conclusion of testing) be written with a unified research design for the entire project in mind. At this point, it is important to point out that the budget figures listed in Table 4 do not include, among other things, a position for a full-time project coordinator who would be responsible for maintaining an overall research design and writing a synthesis of the archaeological work that would contribute to an understanding of cultural dynamics in the Zuni region. Such a position should be considered when final budgets for excavations are written.

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Sites recommended for testing:

ZOW 1	(N. Mex. G:13:19)
ZOW 4	(N. Mex. G:13:22)
ZOW 5	(N. Mex. G:13:23)
ZOW 10	(N. Mex. G:13:28)
ZOW 16	(N. Mex. G:13:34)
ZOW 17	(N. Mex. G:13:35)
ZOW 19	(N. Mex. G:13:37)

Sites recommended for excavation:

ZOW 2	(N. Mex. G:13:20)
ZOW 3	(N. Mex. G:13:21)
ZOW 6	(N. Mex. G:13:24)
ZOW 7	(N. Mex. G:13:25)
ZOW 8	(N. Mex. G:13:26)
ZOW 9	(N. Mex. G:13:27)
ZOW 11	(N. Mex. G:13:29)
ZOW 12	(N. Mex. G:13:30)
ZOW 13	(N. Mex. G:13:31)
ZOW 14	(N. Mex. G:13:32)
ZOW 15	(N. Mex. G:13:33)

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TABLE 3. Archaeological site within and adjacent to the maximum pool area of the proposed Oak Wash Dam that are recommended for either test or complete excavation. The sites are listed by field numbers, followed by Arizona State Museum designations in parentheses.

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Tables 4 and 5 summarize the major areas of expense and time involved in testing and excavation as an initial part of a unified archaeological program for the Oak Wash Dam Project area. An explanation of the budget categories is outlined below.

Supervisory Archaeologist

A qualified archaeologist in immediate charge of excavation and report writing is salaried at \$32.00 per day, a rate established by the Arizona State Museum. The supervisory archaeologist is allotted double the time in the field for preparation of a report. This ratio works reasonably well for relatively small sites, but would have to be increased in final budgets for excavation of those sites scheduled for initial testing that may turn out to be quite extensive.

Assistant Archaeologist

An assistant to the supervisory archaeologist salaried at \$26.00 per day, this individual is omitted in budgets of some small field houses and



Site Number	Supervisory Archaeologist	Assistant Archaeologist	Archaeological Assistant(s)	Draftsman/Surveyor	Laborer(s)	Insurance & Taxes	Field Supplies & Equipment	Report Supplies & Preparation	+40% of Total Direct Costs	Total Direct Costs	Indirect Costs	Total Costs
ZOW 1 (N.M. G:13:19)	480	130	---	---	500	155	50	50	910	2,276	455	2,731
ZOW 2 (N.M. G:13:20)	480	---	100	---	200	109	50	50	659	1,650	330	1,978
ZOW 3 (N.M. G:13:21)	2,350	610	500	---	2,500	834	250	250	4,863	12,157	2,431	14,589
ZOW 4 (N.M. G:13:22)	480	130	---	---	500	155	50	50	910	2,276	455	2,731
ZOW 5 (N.M. G:13:23)	480	130	---	---	500	155	50	50	910	2,276	455	2,731
ZOW 6 (N.M. G:13:24)	2,880	780	1,200	480	3,000	1,168	300	300	6,738	16,846	3,369	20,215
ZOW 7 (N.M. G:13:25)	1,920	520	400	480	2,000	745	200	200	4,310	10,775	2,155	12,930
ZOW 8 (N.M. G:13:26)	2,880	780	600	480	3,000	1,084	300	300	6,282	15,706	3,141	18,847
ZOW 9 (N.M. G:13:27)	1,920	520	400	480	2,000	745	200	200	4,310	10,775	2,155	12,930
ZOW 10 (N.M. G:13:28)	480	130	---	---	500	155	50	50	910	2,276	455	2,731
ZOW 11 (N.M. G:13:29)	1,920	520	400	240	2,000	711	200	200	4,127	10,319	2,064	12,382
ZOW 12 (N.M. G:13:30)	1,440	---	300	360	1,500	504	150	150	2,936	7,340	1,458	8,808
ZOW 13 (N.M. G:13:31)	960	---	200	240	1,000	336	100	100	1,957	4,893	979	5,872
ZOW 14 (N.M. G:13:32)	480	---	---	120	500	154	50	50	903	2,257	451	2,708
ZOW 15 (N.M. G:13:33)	480	---	---	240	500	171	50	50	994	2,485	497	2,982
ZOW 16 (N.M. G:13:34)	960	260	---	---	1,000	311	100	100	1,821	4,551	910	5,462
ZOW 17 (N.M. G:13:35)	1,440	390	300	240	1,500	542	150	150	3,141	7,853	1,571	9,424
ZOW 18 (N.M. G:13:36)	---	---	---	---	---	---	---	---	---	---	---	---
ZOW 19 (N.M. G:13:37)	960	---	---	120	1,000	291	100	100	1,714	4,285	857	5,142
TOTAL												\$145,193

TABLE 4. Preliminary budget for testing, excavation and analysis of archaeological sites within the Oak Wash Dam Project Area. Note that costs may rise between date of this report and initiation of project (figures are rounded).

Site Number	Supervisory Archaeologist (days)	Assistant Archaeologist (days)	Archaeological Assistant(s) (No./days)	Draftsman/ Surveyor (days)	Laborers (No./days)	Backhoe (hours)	Roadgrader (hours)
ZOW 1 (N.M. G:13:19)	15	5	--	--	5/5	16	--
ZOW 2 (N.M. G:13:20)	15	--	1/5	--	2/5	--	--
ZOW 3 (N.M. G:13:21)	75	25	1/25	--	5/25	--	--
ZOW 4 (N.M. G:13:22)	15	5	--	--	5/5	24	--
ZOW 5 (N.M. G:13:23)	15	5	--	--	5/5	24	--
ZOW 6 (N.M. G:13:24)	90	30	2/30	20	5/30	40	--
ZOW 7 (N.M. G:13:25)	60	20	1/20	20	5/20	--	--
ZOW 8 (N.M. G:13:26)	90	30	1/30	20	5/30	--	--
ZOW 9 (N.M. G:13:27)	60	20	1/20	20	5/20	40	--
ZOW 10 (N.M. G:13:28)	15	5	--	--	5/5	40	--
ZOW 11 (N.M. G:13:29)	60	20	1/20	10	5/20	--	--
ZOW 12 (N.M. G:13:30)	45	--	1/15	15	5/15	--	--
ZOW 13 (N.M. G:13:31)	30	--	1/10	10	5/10	--	--
ZOW 14 (N.M. G:13:32)	15	--	--	5	5/5	--	--
ZOW 15 (N.M. G:13:33)	15	--	--	10	5/5	--	--
ZOW 16 (N.M. G:13:34)	30	10	--	--	5/10	--	40
ZOW 17 (N.M. G:13:35)	45	15	1/15	10	5/15	--	40
ZOW 18 (N.M. G:13:36)	--	--	--	--	--	--	--
ZOW 19 (N.M. G:13:37)	30	--	--	5	5/10	--	--

TABLE 5. Time allocations for testing and excavating archaeological sites within the Oak Wash Dam Project area.

test excavations where more than one person supervising workmen is not needed. Generally, if heavy equipment operation and hand excavation is involved, an assistant archaeologist is included in the respective budget.

#### Archaeological Assistant(s)

Personnel trained in laboratory preparation and preliminary analysis of archaeological material are salaried at \$2.50 per hour. Where expected material return from field work would reach a point beyond which the supervisory archaeologist could not handle during the time allotted for analysis and report preparation, archaeological assistant(s) are included for a period of time generally one-half that allotted the supervisory archaeologist for laboratory work.

#### Draftsman/surveyor

Sites that appear to have features dispersed to a certain extent, or that are sufficiently large to warrant the services of a cartographer other than the supervisory archaeologist are budgeted accordingly. The time allowance, in each case, reflects not only time in the field but some time in the laboratory for preparation of site maps for publication. The established salary for a draftsman/surveyor employed by the Arizona State Museum is \$3.00 per hour.

#### Labor

Labor needed to excavate sites is salaried at \$2.50 per hour. Number of laborers needed to excavate or test any one site was calculated on the basis of assumed depth of room fill, trash deposits, and other deposition that would have to be removed to study both the nature of the fill and that of living spaces, architecture, and other cultural features. Much of the excavation was calculated on the basis of five laborers (e.g., one room space taking from two to five days to excavate).

#### Insurance and Taxes

Insurance and taxes are calculated as 14 percent of wages as established at the University of Arizona.

#### Heavy Equipment

In some cases, either a backhoe or road grader (or equivalent) was budgeted when overburden was present in depth or a real extent to such a degree that ordinary labor could not feasibly remove it. In these categories, the amounts indicated in Table 5 are the number of hours budgeted. Because rental fees for heavy equipment vary from locality to locality, no set figure could be arrived at that would compensate for variation in rental charge, depending on the location of the contracting institution involved in the archaeological work.



### Field Supplies and Equipment

Field supplies and equipment used during the excavation are calculated on the basis of \$10.00 per field day.

### Report Supplies and Preparation

Report supplies and preparation are calculated on the basis of \$10.00 per field day.

### Total Direct Cost

Total costs of the above categories combined.

### Total Indirect Cost

Indirect cost is calculated on the basis of University of Arizona rate for National Park Service contracts administered through the Arizona Archaeological Center at 20 percent of direct cost.

### Total Costs

The total cost for any one project is the total direct cost combined with the total indirect cost.

The budgets outlined in Table 4 that are presented as a guide to the monetary value of the archaeological sites within the Oak Wash Dam Project area are based on current cost figures used by the Arizona State Museum with the exception of the category including per diem, travel, special analyses, and laboratory space while in the field. This latter category has been figured on the basis of 40 percent of the total direct cost to help compensate for variations in cost estimates between research institutions that may eventually be responsible for contracting for the excavation and analysis. A review of contract archaeological projects handled by the Arizona State Museum in the past has revealed that a 40 percent figure for the above additional categories is a realistic figure that can be used for the purposes of writing a preliminary budget in the present report. In addition to the categories such as travel, per diem, special analyses (tree-ring and archaeomagnetic dating, pollen analysis, and faunal bone studies), and laboratory space in the field, a position of full-time project coordinator should be included in any final budget considerations.

All of the sites outlined for excavation in the present budget (including both those suggested for testing and those recommended for extensive excavation) are, at this point, intended to be fully excavated based on surface indications of remains. Testing of sites is indicated only where further information needed to answer or meet research objectives that have been broadly outlined in the first section of the present paper. Heavy equipment such as a backhoe has been included where overburden is of sufficient depth to warrant trenching in order to determine the extent

of the archaeological site. A road grader or similar equipment has been budgeted in those cases where overburden is thin and it is necessary to determine the extent of a site based on the location of subsurface features such as pithouses, earth ovens, and the like. Time and labor allotted during such testing projects varies, depending on the amount of hand labor needed to clear trenches cut by backhoe to reveal cultural features such as structures or amount of time, labor, and supervision needed to trace subsurface features partially revealed by a road grader. Extensive excavation of sites, as mentioned previously, was budgeted according to the presumed depth of the cultural remains below the present surface, number of rooms present by surface indications, extent and depth of trash deposits, and adequate testing of the vicinity surrounding the main features of a site (such as room blocks or units) for remains of ramadas or other outdoor activity areas (room spaces are budgeted for complete excavation). The additional testing for ramadas and other activity areas outside of a room block was calculated as a unit of time small in relation to that budgeted for the rooms indicated by surface remains (ranging from 5 - 25 percent of the time allotted for the entire project).

#### Concluding Remarks

Our commitments to the archaeological resources in the Oak Wash area are necessarily related to their preservation whether by excavation and retrieval of information or by the physical preservation of these sites. If a realistic program of protection is formulated for sites not within the maximum pool area of the reservoir but situated around the perimeter of the body of water, then excavation may be avoided. This situation is preferred, although such a program of preservation may be difficult to maintain. In such a case, excavation of sites around the perimeter of the project area, as well as those within the maximum pool area is recommended. The actual excavation is not a total recovery of archaeological remains as indicated by suggestions of testing areas outside of pueblo room blocks for ramada areas and the like, but an organized program designed to recover information valuable to the interpretation of past lifeways from both scientific and humanistic points of view.



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GLOSSARY

Acre-Foot: Quantity of water that would cover 1 acre 1 foot deep; (43560 cubic feet)

Accelerated Erosion: Erosion of soil material at a rate more rapid than that of natural, normal or geologic erosion. Accelerated erosion occurs as a result of destruction of vegetal cover or of some activity of man.

Agricultural Pollution: The liquid and solid wastes from all types of farming, including runoff from pesticides, fertilizer, and feedlots; erosion and dust from plowing, animal manure and carcasses and crop residues and debris.

Crop Residue: Portion of a plant, or crop, left in the field after harvest.

Debris Basin: A barrier built across a stream channel to retain rock, sand, gravel, silt, or other material.

Deferred Grazing: Discontinuance of grazing livestock on an area for a specified period of time during the growing season to promote plant reproduction, establishment of new plants, or restoration of vigor of old plants.

Ecology: The study of the interrelationship of organisms to one another and to the environment.

Floodplain: Nearly level land situated on either side of a channel which is subject to overflow flooding.

Floodway: A channel, either natural or excavated, or bounded by dikes and levees, used to carry excessive flood flows to reduce flooding.

Geological Erosion: The normal or natural erosion caused by geological processes acting over long geologic periods and resulting in the wearing away of mountains, the building up of floodplains, etc.

Grade Stabilization Structure: Structure used to stabilize the bottom grade of a channel.

Growing Season: Frost-free period during which crops can be produced.

Gully Erosion: Removal of soil by temporal passage of water in well defined channels.

Hydrograph: Graphical or tabular representation of flow rate with respect to time.

Improved Cropping Systems: Growing crops in conjunction with tillage practices that will result in a high degree of erosion control and soil improvement and in optimum yields of products.

Irrigation Water Management: The practice of applying irrigation water to the land at a rate, in an amount, and at a time which will supply plant water needs in an efficient manner without significant soil erosion or water loss.

Land Capability: The suitability of land for use without permanent drainage.

Land capability is an expression of the effect of physical land conditions, including climate, on the total suitability for use without damage for crops that require regular tillage, for grazing, for woodland, for wildlife. Land capability classes I through IV are suitable for cultivation. Class I lands are suitable for all land uses and require good soil management practices only. Class II lands are suitable for all land uses but require moderate conservation practices. Class III lands are suitable for land uses that include moderate

cultivation but require intensive conservation practices. Class IV lands are suitable for land uses requiring limited cultivation and should have perennial vegetation.

Land Leveling: Process of shaping the land surface for better movement of water and machinery over the land.

Land Treatment: The application of a combination of practices that will meet specific objectives, including: controlling soil erosion, decreasing runoff of rainfall, improving soil and plant productivity, improving wildlife habitat, increasing efficiency of irrigation water use, and improving environmental quality.

Land Treatment Measures: Those practices that, when applied in the proper combination, will meet the objectives of a resource management system.

Man-Year Equivalent: The amount of labor that can be supplied by an able-bodied man in 1 year or its equivalent.

100-Year Recurrence Interval: The annual flood that is equaled or exceeded once in 100 years. (One percent chance of occurrence.)

One Percent Chance of Occurrence: The probability of occurrence of a 100-year flood in any given year or 1 in 100 years or 0.01. (100-year frequency.)

Pasture Improvement: Any practice of grazing, mowing, fertilizing, lining, seeding, scattering droppings, contour furrowing, or other methods of management designed to improve vegetation for grazing purposes.

Pasture Management: The application of practices to keep pasture plants growing actively over as long a period as possible so that they will palatably feed of high nutritive value.

Permanent Pasture: Grazing land occupied by perennial pasture plants or by self-seeding annuals, usually both, which remains unplowed for many years. Contrast with rotation grazing.



Probable Maximum Precipitation (PMP): An estimate of the physical upper limit to the amount of precipitation that can fall over a specific area in a given time.

Proper Grazing Use: Grazing ranges and pastures in a manner that will maintain adequate cover for soil protection and maintain or improve the quality and quantity of desirable vegetation.

Rainfall Frequency: Frequency, usually expressed in years, at which a given rainfall in intensity and duration can be expected to be equalled or exceeded.

Rainfall Intensity: Rate of rainfall for any given time interval, usually expressed in inches per hour.

Rangeland: Land that is grazed by domestic livestock and big game animals on which the plant community is comprised of native grasses, forbs, and shrubs.

Range Management: The application of a combination of practices designed to meet needs and objectives in relation to the specific use of rangeland. Included are planned grazing systems, as well as practices to control livestock grazing, re-establish plant cover, and to improve quality and quantity of forage.

Range Seeding: Establishing adapted plant species on ranges by means other than natural revegetation.

Range Site: A distinctive kind of rangeland that differs from other kinds of rangeland in its potential to produce native plants.

Rotation Pasture: A cultivated area used as a pasture one or more years as a part of crop rotation.

Runoff: The portion of precipitation or irrigation which is returned to the stream as surface flow.

Sedimentation: Deposition of water borne sediments due to a decrease in velocity and a corresponding reduction in the size and amount of sediment which can be carried.

Sheet Erosion: The removal of a fairly uniform layer of soil from the land surface by runoff water.

Tributary: Branch of a stream, ditch, drain, or other channel which contributes flow to the main channel.

Watershed: Total land area above a given point on a stream or waterway that contributes runoff to that point.



## APPENDIX H

COMMON PLANT NAMES

Common Name	Plant Characteristics	Plant Symbol	Scientific Name
Big sagebrush	NS	ARTR2	<i>Artemisia tridentata</i>
Blue grama	PNG	BOGR2	<i>Bouteloua gracillis</i>
Broom snakeweed	NHS	GUSA2	<i>Gutierrezia sarothrae</i>
Fourwing saltbush	NS	ATCA2	<i>Atriplex canescens</i>
Galleta	PNG	HIJA	<i>Hilaria jamesii</i>
Gambel oak	NT	QUGA	<i>Quercus gambelii</i>
Greasewood	NS	SAVE	<i>Sarcobatus vermiculatus</i>
Indian ricegrass	PNG	ORHY	<i>Oryzopsis hymenoides</i>
Muttongrass	PNG	POFE	<i>Poa fendleriana</i>
One seed Juniper	NT	JUMO	<i>Juniperus monosperma</i>
Pinyon pine	NT	PIED	<i>Pinus edulis</i>
Rocky Mountain Juniper	NT	JUSC2	<i>Juniperus scopulorum</i>
Rubber rabbitbrush	NS	CHNA2	<i>Chrysothamnus nauseosus</i>
Sand dropseed	PNG	SPCR	<i>Sporobolus cryptandrus</i>
Sandscale	NS	ATCO	<i>Atriplex confertifolia</i>
Side-oats grama	PNG	BOCU	<i>Bouteloua curtipendula</i>
Threeawn	G	ARIST	<i>Aristida</i> spp.
Western wheatgrass	PNG	AGSM	<i>Agropyron smithii</i>

LEGEND FOR PLANT CHARACTERISTICS

A - Annual	I - Introduced
B - Biennial	N - Native
E - Emergent	P - Perennial
F - Forb	S - Shrub
G - Grass	S4- Succulent
GL- Glass-Like Plant	T - Tree
HS- Half Shrub	WV- Woody Vine





